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Interstate 10 Western Connected Freight Corridor, Volume 2: Planning Framework

Arizona Department of Transportation Research Center

ADOT

Interstate 10 Western Connected Freight Corridor, Volume 2: Planning Framework

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16. Abstract

The Interstate 10 (I-10) western connected freight corridor extends from the Ports of Long Beach and Los Angeles in California to the Port of Beaumont in Texas. Collaborating through a Federal Highway Administration (FHWA) pooled fund study, the state departments of transportation in California, Arizona, New Mexico, and Texas (the I-10 Corridor Coalition) produced a planning framework for a connected freight corridor.

The planning framework serves two purposes: It describes the major strategies to improve freight operations within the identified I-10 corridor, developed in response to stakeholder input and industry assessments. It explains functions and relationships required for the effective implementation of technologies and systems associated with the five chosen strategies: truck parking availability systems, freight traveler information systems, freight technology environment, roadside safety communication, and oversize-overweight permit standardization.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

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LIST OF ACRONYMS

ADOT ....Arizona Department of Transportation
AFTIS.................Automated freight traveler information systems
AV ....Automated vehicle
CAV...................Connected vehicle and/or automated vehicle
CHP...................California Highway Patrol
CMV..................Commercial motor vehicle
CV ....Connected vehicle
DMS..................Dynamic message sign
DOT ....Department of transportation
EB ....Eastbound
GIS ....Geographic information system
HOS ....Hours of service
OS/OW ....Oversize and/or overweight
POE...................Port of entry
V2I ....Vehicle-to-infrastructure
WB....................Westbound
WIM ....Weigh-in-motion

CHAPTER 1. INTRODUCTION AND PROCESS

In June 2016, the chief executives of the state departments of transportation (DOTs) for California, Arizona, New Mexico, and Texas executed a charter to create the I-10 Corridor Coalition to enhance safe and efficient freight movement by integrating existing corridor infrastructure through institutional and stakeholder collaboration. Collaborating through a pooled fund study supported by the Federal Highway Administration, the Coalition's first project is the development of a planning framework for a connected freight corridor.

The *Interstate 10 (I-10) Western Connected Freight Corridor Planning Framework* serves two purposes:

- It describes the major strategies to improve freight operations within the identified I-10 corridor, developed in response to stakeholder input and industry assessments.
- It explains functions and relationships required for the effective implementation of technologies and systems associated with the strategies.

PROJECT LIMITS

The I-10 western connected freight corridor (referred to herein as corridor) is the I-10 segment from the Ports of Long Beach and Los Angeles in California to the Port of Beaumont in Texas. Figure 1 shows the study section of I-10 and associated major urban areas.

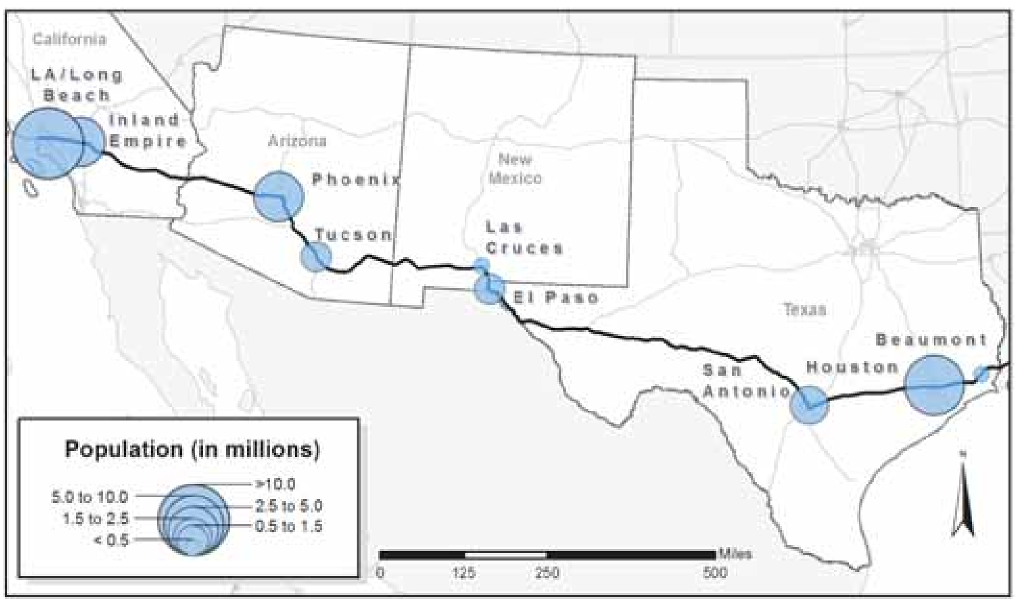


Figure 1. Interstate 10 Western Connected Freight Corridor

CORRIDOR STRATEGIES

Surveys, interviews, and workshops with public- and private-sector freight stakeholders yielded data and insights that helped identify a range of strategies and technologies to improve freight movement in the corridor. The four corridor states agreed to pursue the five strategies that follow.

Advanced Freight Traveler Information Systems

Stakeholders consistently noted the value of more thorough, more accurate, and more timely information about traffic conditions in the corridor. This information would include locations and severity of congestion and would expand on current traffic conditions data by including, as much as possible, forecasted travel conditions. The I-10 advanced freight traveler information system would provide travel time, weather, and incident information to regional and long-haul trucking company operations staff, dispatchers, and drivers who move all types of freight on the I-10 corridor. The information would be as consistent as possible with standard trucking company operational terminology and dispatching functions/systems. This information would ideally be provided electronically and through multiple delivery channels, such as websites, e-mail alerts, mobile applications, outputs to dynamic messaging signs (DMSs), and outputs to regional traveler information centers/511 centers.

Truck Parking Availability Systems

Truck parking needs can be divided into two categories: a lack of supply and a lack of information. According to state freight plans published by the four coalition states, demand for truck parking exceeds the available supply in some locations on the I-10 corridor. Drivers often do not know where to find parking spaces (public or private) that may be available. The mismatch of truck parking supply and information affects carrier productivity and driver safety. The corridor geographic information system (GIS) database compiled in this study identified approximately 11,500 truck parking spaces in the corridor. Of those, approximately 550 spaces are available at 37 public rest areas. In 2018, the coalition applied for an Advanced Transportation and Congestion Management Technologies Deployment grant to fund a truck parking availability system that would deploy technology at the 37 public facilities to identify unused spaces and make this information available to drivers through several dissemination tools, including dynamic parking availability signs, mobile smartphone applications, and web applications such as state 511 systems. The submitted application, for which a decision is pending at the time of publication, is included as the Appendix.

Highway Environment Conducive to Delivery of the Next Generation of Advanced Technologies

Most commercial fleet operators interviewed believe that significant regulatory, insurance, privacy, proprietary, and liability issues must be resolved before connected vehicle/automated vehicle (CAV) technologies can be widely adopted in commercial fleets. These carriers indicated that they would expect national standards and requirements for CAV systems and equipment, since any CAV equipment or application would need to work in every state—not just the four western I-10 states. They indicated that tractors and trailers must be able to move freely where business takes them. As these national standards are being considered, stakeholders have encouraged the coalition states to develop a blueprint for future actions to support the trucking industry's incremental adoption of semi-automated operations (truck platooning) by 2024, and large-scale autonomous truck deployments by as soon as the mid-2020s. Coalition states were encouraged to prepare for future developments in automated vehicles (AVs) and connected vehicles (CVs)—and their combination (CAVs). Coalition states would need to plan for the technologies and develop infrastructure to enable and support vehicle-to-infrastructure (V2I) communications.

Roadside Safety Communication

Corridor stakeholders identified a need for improved roadside safety-related communications to support enforcement, vehicle inspection, and driver safety monitoring for trucks using the I-10 corridor. The possible technologies and systems include:

- Electronic screening (e-screening), involving automatic identification and safety assessment of a commercial vehicle in motion.
- Virtual weigh stations/electronic permitting, in which roadside technologies can be used to improve truck size and weight enforcement.
- Wireless Roadside Inspection Program, examining technologies that send safety data (on the driver, vehicle, and carrier) directly from the vehicle.

The I-10 roadside safety communication strategy would develop the truck-road infrastructure necessary to improve the efficiency of state enforcement personnel monitoring and screening of trucks, and to promote a new type of wireless, rapid truck safety inspection that covers truck brake wear, tire pressure, and driver hours of service (HOS). Commercial vehicle safety enforcement agencies would be able to share information on carrier inspections and enforcement actions along the corridor to aid in e-screening uninspected vehicles.

Permitting Standardization

When carriers and shippers need to move oversized goods on specialty vehicles through more than one state along the I-10 corridor, they must often duplicate shipment information in multiple permitting systems. Stakeholders might expect that common data elements in the oversize and overweight (OS/OW) permits of all four states could be shared across each state's permitting platforms. According to stakeholders on the I-10 corridor, a single OS/OW move can take six to eight weeks to plan, involving coordination across multiple permitting systems. Coalition states could build on an OS/OW standardization initiative begun by the Western Association of State Highway and Transportation Officials to create baseline operational rules (escorts, time-of-day restrictions, and signage) and permit information sharing. This process could also take a systems approach to provide some basic automation to a new standardized permitting process that covers the four states. These back-office systems would depend on the legislative authority of the four states to share permit information outside each state's permitting applications system.

CHAPTER 2. IMPLEMENTATION IMPACTS

Deploying the corridor strategies would impact several elements of the freight operating environment—facilities, equipment (in the field and on the trucks), software, personnel, and procedures—as described below:

- Facilities (centers): Facilities where public and private entities monitor information about traffic conditions, construction zones, weather information, parking availability, vehicle movements, shipments, truck condition, and driver status. This would include public traffic management centers and private dispatching operations of motor carriers.
- Equipment (field): Sensors, cameras, detectors, and other equipment found along the roadside or in the pavement, designed to measure performance, detect conditions, and diagnose problems. This could also include similar kinds of equipment in private truck parking lots or shipping and receiving yards.
- Equipment (trucks): Devices similar to field equipment (sensors, cameras, detectors) but found on the truck itself. These devices or on-board units can be outward facing to improve operations (lane departure warnings, automated braking, and cruise control) or can be oriented toward the driver (alertness, time keeping) or to the vehicle (condition of engine, brakes, axles).
- Software: Computer-based systems to integrate information to, from, and among vehicles, infrastructure, motor carriers, shippers, and facility owners.
- Personnel: People involved in direct operations, maintenance, information technology, and other systems associated with vehicles and infrastructure along the corridor.
- Procedures: Formal and informal practices, rules, and policies that define the relationships among public and private agencies and individuals who own and use the I-10 corridor and the facilities along it.

Table 1 describes high-level impacts of each of the five strategies on the elements above.

Table 1. Impacts of Deploying Connected Freight Strategies on the Interstate 10 Western Corridor

	Truck Parking Availability Systems	Advanced Freight Traveler Information Systems	Highway Environment Conducive to Next-Generation Technologies	Roadside Safety Communication	Permitting Standardization
Facilities (Centers)	Use existing centers and integrate systems with public and private parking information.	Use existing urban-based centers and integrate and expand systems into rural areas.	Use new center(s) with new stakeholders (CAV operators).	Use existing law enforcement centers and systems but with broader integration, requiring inter-agency coordination.	Use existing permitting agency platforms and integrate systems, with more permit information shared among state systems.
Equipment (Field)	New field equipment and communications will be needed at parking sites.	Expand detection systems (congestion, construction, weather) and roadside communication (DMSs).	Enhanced roadway maintenance (striping, lane markers, signs) needed for onboard CAV cameras and sensors.	Roadside detection device functions may include infrared sensors (brakes) and vehicle-based information transmission.	Most permitting systems are centralized, not distributed in the field.
Equipment (Trucks)	Parking information can be sent to smartphones and other onboard devices.	Real-time incident information needs to be available to dispatchers and onboard devices.	Expanded instrumentation of trucks. Communications from trucks to roadway.	Onboard diagnostics on vehicle condition and driver HOS are needed.	Vehicle-based permit information available for law enforcement across state lines.
Software	Support deployment of field equipment and services; share information with multiple systems.	Support integration of data from relevant centers into communication platforms.	Enable new applications and technologies as they develop and deploy along the corridor.	Integrate inspection records and preclearance across state lines.	Share and distribute baseline permit details in all states.
Personnel	Modest resources needed for parking information centers, detection installation, and maintenance.	May require additional staff to monitor rural conditions and incidents in traffic management centers.	Incorporate freight corridor needs within other DOT technology initiatives.	Streamline operations while improving effectiveness among existing staffing levels.	Permit staff will need to be trained to adjust multistate permit applications to individual state requirements.
Procedures	Drivers, dispatchers, and truck stops may need to add truck parking reservation procedures as reserved parking expands to more facilities.	DOTs and law enforcement agencies may need scripts and procedures for a range of incident and weather management scenarios.	Carriers, shippers, law enforcement agencies, and insurers may need to adopt protocols for new technologies.	Federal and state carrier safety information data used in enforcement screening may need improvement and acceptance.	State permit agencies may need to adopt agreements to share data and permit information.

TRUCK PARKING AVAILABILITY SYSTEMS

Truck parking availability systems provide timely information about truck parking opportunities. While the focus of implementing this strategy is on integrating existing systems, states may also need to increase the deployment of field equipment to track and manage parking in public rest areas. When deploying corridor strategies, the two most affected elements would be:

- Equipment (field): DOTs seeking to connect public rest areas to truck parking information systems may consider what kinds of devices will measure parking space occupancy and availability.
- Equipment (truck): Drivers have different kinds of in-cab communications devices that connect to dispatchers, traffic information systems, HOS logging systems, and business and personal smartphones. Effective truck parking information systems provide information on availability (and ultimately on reservations) to drivers and dispatchers already using different kinds of devices.

ADVANCED FREIGHT TRAVELER INFORMATION SYSTEMS

The private and public sectors offer various forms of traveler information along most roadways, including I-10. The private sector provides this information through software-enabled services such as mapping applications (Google and Apple), Waze, and HERE. The public sector provides the information through web services and applications, such as Arizona Department of Transportation's (ADOT's) Traveler Information System AZ511.gov, and roadside dynamic message signs (DMSs) that post roadway conditions. When deploying corridor strategies, two affected elements would be:

- Facilities: State DOTs and metropolitan planning organizations with urban traffic information centers may plan how to enable communication among statewide traffic centers to cover the hundreds of miles of rural highway. To collect the construction lane closure information stakeholders have requested, DOTs may consider requiring more detailed and frequent information (such as real-time lane closures) from highway construction contractors and then sharing that information with multiple carrier systems, across state lines, and in both rural and urban areas.
- Procedures: DOT traffic information centers often have procedures for responding to incidents based on how many first responders are called to the scene of a crash. DOTs may want to consider how to connect with the multiple law enforcement agencies along the corridor to get information on incident severity (one of the major needs heard in stakeholder outreach) and communicate the relative congestion impacts of traffic incidents.

HIGHWAY ENVIRONMENT CONDUCIVE TO NEXT-GENERATION TECHNOLOGIES

Carriers have indicated that they would expect standards and requirements for CAV systems and equipment to be developed at a national level, not state-by-state. States might seek to accommodate new technologies through incremental improvements of existing systems and operations centers. New in-vehicle hardware could have significant impacts on public infrastructure and roadside communications as private-sector automation and new communications technologies roll out. When deploying corridor strategies, two affected elements would be:

- Equipment (field): Roadway information from pavement markings, retroreflective markers, and regulatory/advisory signs need to be machine readable by the cameras and sensors of autonomous vehicles. States can ensure that markings and signage offer high contrast for cameras, or that signs are embedded with infrared or non-visible markings that convey information to sensors.
- Procedures: National and state regulations may require amendments or adjustments to respond to increasing automated capabilities of new equipment. States may consider pursuing special-purpose legislation that allows platooning vehicles to follow more closely than allowed by standard traffic rules, or instituting regulations that allow or encourage autonomous vehicle operations.

ROADSIDE SAFETY COMMUNICATION

States may consider pursuing the development of the commercial motor vehicle (CMV) V2I communications infrastructure to enable state enforcement personnel to more efficiently inspect trucks for compliance with safety requirements. With new infrastructure in place, inspections of truck brake wear, tire pressure, and driver HOS could be conducted rapidly and wirelessly. The infrastructure would also put new demands on truck fleets for added onboard hardware and communications. When deploying corridor strategies, two affected elements would be:

- Equipment (field): As trucks are equipped with more onboard monitoring systems, the public sector will be interested in discovering the right mix of sensors and communications devices to communicate directly with the trucks rather than with a transponder or smartphone.
- Procedures: The public and private sectors will face the challenge of agreeing on how to share private onboard truck data with public law enforcement agencies, both remotely (at driving speeds) and during roadside inspections.

PERMITTING STANDARDIZATION

The standardization of OS/OW truck permitting requirements across multiple states would require the states to analyze laws and regulations, clarify permitting processes, and engage in intergovernmental negotiations. The OS/OW permitting agencies in New Mexico and Texas are not signatories to the

I-10 corridor charter, and while they eventually may be sympathetic to the goals of this strategy, more outreach and communication may be necessary to achieve permit standardization across state lines. When deploying corridor strategies, two affected elements would be:

- Facilities (centers): Each permitting agency can expect to develop processes to share information on multistate permit moves with all agencies across state lines so that applicants do not duplicate effort and commerce can move freely along the corridor.
- Procedures: The permitting agencies may need to identify baseline information necessary for coordination, understanding that each state has unique regulations.

COALITION IMPLEMENTATION PRIORITIES

Considering these implementation issues along with the benefits of and barriers to implementation, the coalition states have selected two of the five strategies—truck parking availability systems and advanced freight traveler information systems—for the near-term focus of planning and deployment. Table 2 lists the coalition's priorities for the five strategies in light of the following practical elements affecting the strategies:

- Available resources: What public and private resources are available to support implementation of the strategies? Current federal discretionary grants have been awarded to states for truck parking availability systems and for advanced freight traveler information systems. Private venture capital is also fueling multiple freight technology ventures in truck automation and platooning. Funding for Priorities 4 and 5 shown in Table 2 is less extensive and may require state-level funding.
- Strategy readiness: How soon could the strategies be deployed? Priorities 1 and 2 in Table 2 are well defined but would require planning and additional field assets. Although freight technologies (Priority 3) are being tested, the regulatory and legal requirements are unclear. The trucking fleet is not adopting onboard screening and diagnostic systems uniformly (Priority 4), and public access to this onboard screening data is not mandated. Finally, OS/OW permit standardization (Priority 5) would require revisions to state laws.
- Public-sector and private-sector roles: How does the relative ownership and responsibility for these strategies fall among the public and private sectors? At first, truck parking information systems will focus on public assets, but the ultimate goal is to include private truck stops, which control many more spaces. The deployment of new freight technologies will likely be driven by companies creating the technologies and the carriers adopting them. Roadside communication and permitting standardization primarily involve the public sector, since public agencies own the assets or are responsible for the regulations.
- Implementation outlook: All things considered, what are the overall prospects for strategy implementation?

Table 2. Interstate 10 Western Freight Corridor Strategy Priorities

	Truck Parking Availability Systems	Advanced Freight Traveler Information Systems	Highway Environment Conducive to Next-Generation Technologies	Roadside Safety Communication	Permitting Standardization
Coalition Priority	1	2	3	4	5
Time Horizon	Short	Mid-term	Long term	Long term	Long term
Available Resources	Robust public funding	Robust public funding	Robust private funding	Limited funding	Limited funding
Strategy Readiness	Public systems in deployment; private apps available	Data collection in place; incident severity metrics less defined	Multiple systems being tested; institutional relationships to be determined	E-screening not universal among fleets; unclear public access to levels of onboard data	Some permit information sharing could be possible given state laws
Public/Private-Sector Roles	Early: 80%/20%; Ultimate: 30%/70%	70%/30%	20%/80%	70%/30%	80%/20%
Implementation Outlook	Coalition applied for grant for public parking; high priority for industry	Need expansion to rural areas, connection to carrier systems; could create competitive advantage	Extensive private deployments underway; public roles to be clarified	Need common public standards among agencies; issues of private data sharing unclear	Regulatory regimes vary among coalition states; harmonization is needed

CHAPTER 3. HOW WOULD THE STRATEGIES WORK?

What would be the practical impacts for state agencies, freight shippers, and carriers if all five corridor strategies were to be deployed? This chapter presents two conceptual scenarios of events that involve interactions of the roadway environment, the freight movements associated with a driver and carrier, and the agencies and procedures that guide that movement. The scenarios show the interactions that allow the corridor strategies and functions to achieve their collective missions. These scenarios provide a picture of the corridor operating in its built-out configuration and supplying the services that the coalition has identified in the five strategies included in this planning framework.

SCENARIO 1: AUTOMATED TRUCK MOVEMENT FROM EL PASO, TEXAS, TO RIVERSIDE, CALIFORNIA

This scenario is suggested by and expanded upon from current shipments of white goods (refrigerators and washing machines manufactured in maquiladoras in Mexico) from El Paso to California along I-10 using driver-assisted autonomous truck operations (Embark is an autonomous truck company that is currently shipping Electrolux/Frigidaire goods from El Paso to the Los Angeles area). In this scenario, the driver hopes to make the entire journey within the allowed 11-hour HOS window. This scenario is described in more detail in the step-by-step elements in Figure 2, which shows the location of each step by number, as then detailed in Table 3.

The envisioned trip begins at a yard in El Paso, Texas, as a driver in a standard tractor picks up a trailer filled with refrigerators and drives it to a transition point along I-10. Once there, the driver unhooks the trailer, and the trailer is then connected to an autonomous tractor with partial driver control. That truck carries the load 650 miles along I-10, handing it off to a driver at a transition point somewhere between Indio and Palm Springs, California, where the trailer is switched to a standard tractor for operations in the urban area with more traffic and more complicated street networks. That standard tractor and trailer is driven to an Electrolux distribution center in Riverside, California.

Figure 2. Interstate 10 Scenario 1 Conceptual Representation: Automated Truck Movement from El Paso, Texas, to Riverside, California

Table 3. Interstate 10 Scenario 1 Detailed Steps

1	**6:00 a.m.**, Mountain Daylight Time (MDT), Socorro, Texas, warehouse. Trailer of white goods leaves warehouse with conventional tractor and travels to I-10/Horizon Blvd Flying J Truck Stop in Sparks, Texas, southeast of El Paso.
2	**6:15 a.m.**, Flying J Truck Stop. The driver of an automated, instrumented Embark tractor exchanges the Electrolux trailer. The driver of the autonomous tractor enters change-of-duty status into the electronic log and begins the trip by driving the truck onto westbound (WB) I-10 and then enabling autonomous operation of the vehicle. Across the planned initial route and potential alternative routes, roadway curves and grades must be compatible with AV systems, and each corridor state has authorized the AV truck trip. The driver follows instructions for autonomous operation of the tractor as set by the Embark dispatchers and systems analysts. In areas of heavy traffic or work zones where there may be many curves through the zone, off-ramps or on-ramps, or off-interstate travel, the driver keeps full control of the vehicle. Elsewhere and where appropriate (i.e., steady traffic on interstate roads that are relatively straight), the driver enables autonomous vehicle operation.
3	**6:30 a.m.**, El Paso, Texas. Driver receives information from the Automated Freight Traveler Information System (AFTIS) on work zones and congestion in El Paso in advance of early morning rush hour. The dispatcher and driver discuss traffic conditions, construction, or weather information to determine final routing. Detecting no expected en-route delays, the trip is routed according to original plans. Had there been delays of sufficient duration or posing risks for the AV (congested driving conditions), then alternative routes would either be calculated at the dispatch center or in the vehicle or be suggested by the AFTIS. Alternatively, if traffic incidents of extended delay were to occur, the driver could, based on parking availability, park the vehicle and conserve HOS and fuel by waiting until normal traffic conditions are restored. Although no delays are expected through the El Paso area, as a precaution, the driver takes manual control of the vehicle until traffic thins out west of El Paso, at which time the driver reengages autonomous operation of the vehicle.
4	**7:30 a.m.**, Anthony, New Mexico. The driver approaches the Anthony Port of Entry (POE) (24-hour operations) and CMV safety inspection/weigh station. The vehicle's transponder conveys vehicle/driver/carrier information through the Pre-Pass/Drivewyze system, and the truck is cleared to move along without stopping. Based on proximity to a weigh/inspection station, as the truck approaches, an automated check and verification of the driver, vehicle, and motor carrier unique identifiers is launched. The vehicle's weight is also verified via a weigh-in-motion (WIM) scale upstream of the station. If the credentials check, the carrier is known to be low risk in terms of safety compliance, and if the vehicle weights are in compliance, then the driver/vehicle receives a green light in advance of inspection/weigh station via mobile app.

Table 3. Interstate 10 Scenario 1 Detailed Steps (Continued)

5	**9:30 a.m.**, Lordsburg, New Mexico. The driver pulls into a truck stop for a 15-minute bathroom break and snack. The driver checks AFTIS information systems for construction, weather, and congestion information about Tucson and Phoenix coming up to the west. The driver works with the dispatcher to check traffic conditions, construction, or weather information to determine final routing. Expecting no en-route delays, the trip is routed according to original plans.
6	**9:15 a.m.**, Mountain Standard Time (MST), San Simon, Arizona (where Daylight Savings Time is not observed). Driver approaches San Simon POE and CMV safety inspection/weigh station past the Arizona state line. The vehicle transponder conveys vehicle/driver/carrier information through the Pre-Pass/Drivewyze system, and the truck is cleared to move along without stopping. Arizona law enforcement is aware of the truck passing the earlier New Mexico checkpoint (Step 4) without incident. The preclearance process is executed with the same process detailed in Step 4 above.
7	**10:45 a.m.**, Tucson, Arizona. Driver enters urban section of I-10 in Tucson and receives any updated AFTIS information. ADOT crews have maintained the interstate section to remove debris and tire carcasses and kept clear pavement markings and reflectivity on all signage so that onboard cameras and sensors can uphold lane integrity in higher traffic areas. Based on the truck's location, traffic information is relayed to the truck indicating near free-flow road conditions. Driver maintains the automated status of the vehicle.
8	**12:30 p.m.**, Phoenix, Arizona. Driver pulls off interstate into truck stop for a 15-minute break and to access lunch stored in his/her onboard cooler (cumulative driving hours: 6:30). Driver takes control of the truck and pulls into the truck stop. Driver checks messages and AFTIS information. He/she sees that conditions are clear going forward.
9	**12:45 p.m.**, Phoenix, Arizona. Driver pulls back onto I-10 westbound. Driver reengages autonomous operation once safely on the interstate.
10	**2:45 p.m.**, Ehrenberg, Arizona. Driver approaches Ehrenberg POE and is cleared through preclearance lanes. Arizona law enforcement has records of preclearance events from earlier in the day. The preclearance process is executed with the same process detailed in Steps 4 and 6 above.
11	**3:15 p.m.**, Pacific Daylight Time (PDT, same as MST), Blythe, California. Driver approaches the WB Blythe California Highway Patrol (CHP) weigh station and is cleared through preclearance lanes. California law enforcement has records of preclearance events from earlier in the day in other states. The preclearance process is executed with the same process as in Steps 4, 6, and 10 above.

Table 3. Interstate 10 Scenario 1 Detailed Steps (Continued)

12	**3:45 p.m.**, Desert Center, California. At this point, without any delays, the driver is at nine hours and 30 minutes of cumulative driving time. If the driver had experienced any delays along the route due to construction, congestion, or weather, or from stopping at POEs, or if WB traffic en route to Riverside had been congested, then the driver and dispatcher would have identified a safe place to park somewhere between Indio and Palm Springs (suitably safe for the expensive automated tractor). The driver and dispatcher would have accessed the I-10 truck parking availability system to find information on public and private truck parking availability. If en-route traffic advisories warned of severe weather or incidents ahead on the truck's route that would exhaust the driver's available HOS, and if no reasonable alternate route were available, the trucking dispatch center would approve the driver's layover at an approved truck stop just inside the state line. Parking availability at truck stops would be checked and a reservation would be made by the dispatch center on behalf of the driver or by the driver via a mobile application. The application would connect the driver to a corridor-wide truck parking availability/reservation system and allow the driver to see predicted availability at upcoming truck stops and to reserve a parking space. A conventional tractor would then be dispatched to pick up the trailer at the truck stop to continue its trip to final destination.
13	**5:30 p.m.**, Banning, California. Without any other delays, and with the application of all other I-10 corridor functions, the driver reaches the CHP weigh and inspection station at Banning and exchanges the trailer with a conventional tractor. The conventional tractor (and new driver) takes the tractor 30 miles into the Riverside, California, warehouse. The conventional tractor may have pulled a trailer for the autonomous tractor to make a return trip the following day. The driver of the autonomous vehicle, having exhausted his/her available HOS, goes off duty until the next day when he/she makes the return trip with a trailer brought to him/her or as a bobtail run (without a trailer).

SCENARIO 2: OS/OW MOVEMENT FROM LONG BEACH, CALIFORNIA, TO FORT STOCKTON, TEXAS

This scenario envisions a permitted OS/OW load for specialty oil and gas drilling equipment manufactured in Asia, shipped through the Port of Long Beach, and destined for wells outside Fort Stockton, Texas. This scenario is described in more detail in the step-by-step elements in Figure 3, which shows the location of each step by number as then detailed in Table 4.

In advance of the OS/OW shipment, the specialty carrier could be expected to use a newly standardized permitting system, and by entering shipment information and manifests into the California permit agency, the baseline permit information for this shipment would be shared among the permit systems for Arizona, New Mexico, and Texas. This information sharing among the I-10 corridor states would make the OS/OW permit process much more streamlined.

Once the information is processed, the states return their OS/OW approvals (including routing instructions and/or route restrictions), and fees are electronically paid by the carrier; a multistate OS/OW permit is then issued via fax, e-mail, or mobile device.

Figure 3. Interstate 10 Scenario 2 Conceptual Representation:
OS/OW Movement from Long Beach, California, to Fort Stockton, Texas

Table 4. Interstate 10 Scenario 2 Detailed Steps

Day One	
1	**7:00 a.m.,** Pacific Standard Time (PST), Port of Long Beach Terminal, California. The specialty motor carrier arrives at the terminal, and the specialty drilling equipment is loaded and secured on an OS/OW tractor trailer. The driver continues 90 miles along I-710, I-605, and CA-60 to I-10 in Beaumont, California. The driver makes use of AFTIS information on road conditions, congestion, and weather. The driver and dispatcher consult traffic condition, construction, or weather information from the AFTIS system for final routing, assuming approved alternate routes are available and are forecast to improve the trip according to carrier parameters (such as on-time or least-miles routing decisions). In this example, since no expected en-route delays are revealed, the OS/OW trip is routed according to the original plans. The carrier and shipper/receiver can determine the location of the truck/load through onboard satellite tracking systems.
2	**10:00 a.m.,** Beaumont, California. The driver enters I-10 eastbound (EB).
3	**10:15 a.m.,** Banning, California. The driver approaches the Desert Hills EB weigh station. Based on proximity to a weigh/inspection station, as the truck approaches, roadside communication systems begin an automated check and verification of the driver, vehicle, and motor carrier unique identifiers. The vehicle's weight is also verified via a WIM scale upstream from the station. The driver enters the POE. Even though the carrier participates in preclearance programs, today this OS/OW load is randomly checked to make sure the proper permits are in place and the load is secured properly. This process takes no more than 15 minutes. The driver takes a short break during this permit check. Following clearance through the POE, the driver pulls the truck back onto EB I-10.
4	**12:30 p.m.,** MST, Ehrenberg, Arizona. The driver approaches the EB Ehrenberg POE weigh station and is waved through preclearance lanes. This is possible because Arizona law enforcement has records of the permit check from earlier the same morning in Banning.
5	**2:30 p.m.,** Avondale, Arizona. The driver exits I-10 for the Pilot Truck Stop and takes a short break, buying lunch for the road. The driver checks the AFTIS system for congestion and traffic information ahead in Phoenix and Tucson and sees that conditions are clear going forward.
6	**4:30 p.m.,** Tucson, Arizona. Without any other delays, the driver is now at nine hours cumulative driving time and needs to find truck parking sometime in the next two hours. The driver can communicate with the dispatcher to check the truck parking availability system for available parking in the section of rural Arizona ahead. The dispatcher finds parking available at a truck stop at Exit 340 in Willcox, Arizona.
7	**5:45 p.m.**, Willcox, Arizona. Driver exits I-10 and enters the truck stop to park for the night.

Table 4. Interstate 10 Scenario 2 Detailed Steps (Continued)

Day Two	
	6:00 a.m., MST, Willcox, Arizona. Driver re-enters EB I-10.
9	**10:00 a.m.**, MST, Anthony, New Mexico. The driver comes up on the Anthony POE (24-hour operations) and CMV safety inspection/weigh station. The truck's transponder conveys vehicle/driver/carrier information through the Pre-Pass/Drivewyze system, and the truck is cleared to move along without stopping. New Mexico law enforcement has information on permit checks in California from the previous day. The preclearance process is executed with the same process detailed in Step 4 above.
10	**1:00 p.m.**, Central Standard Time (CST), Van Horn, Texas. The driver comes up on a Texas DPS weigh station. The vehicle transponder conveys vehicle/driver/carrier information through the Pre-Pass/Drivewyze system, and the truck is cleared to move along without stopping. Texas law enforcement has information on permit checks in other states from this trip. The preclearance process is executed with the same process detailed in Steps 4 and 9 above.
11	**1:15 p.m.**, Van Horn, Texas. The driver stops at a Pilot Truck Stop in Van Horn for a short break and to pick up lunch for the road.
12	**1:30 p.m.**, Van Horn, Texas. Driver returns to EB I-10.
13	**3:15 p.m.**, Fort Stockton, Texas. The driver exits I-10 and continues north on US 285 to deliver the load to a well site 20 miles northwest of Fort Stockton.

CHAPTER 4. NEXT STEPS

This planning framework equips the four states in the pooled fund study to move ahead with strategy implementation. The framework describes corridor needs, high-priority strategies, stakeholders, and the role of the stakeholders. Funding opportunities, contracting mechanisms, public-sector input, legislation, and other factors will guide the implementation of these strategies. The sequence and scope of implementation projects will drive next steps, such as developing system requirements and design.

GENERAL IMPLEMENTATION PROCESS

Each strategy will require a different path to implementation, but generally, they involve transportation technologies that are put into practice through a standard systems engineering process familiar to the state DOTs. That process involves the following steps:

- System requirements: In the requirements step, stakeholder needs are reviewed, analyzed, and transformed into verifiable requirements that define what each corridor strategy system will do for a specific project but not necessarily how the system will do it. Working closely with stakeholders, the requirements are gathered, analyzed, confirmed, documented, and baselined. Developing the system requirements involves integrating existing systems and deployments in the corridor. The coalition states may consider contracting with a systems integrator that can represent the states as the strategies are designed and installed.
- Design: This step describes how the requirements will be met, how interfaces are detailed, how requirements are distributed to systems components, and how final off-the-shelf products are selected. As the states work on specific systems along the corridor, the agencies explore the types of services and products that may be available through existing contracts. For instance, it may be possible to obtain a specific device or service through a current contract with a partnering state DOT. Taking advantage of such collaborations could help speed the build process and provide more consistency in products and services along the corridor.
- Software/hardware development and installation: The next step is to obtain the systems that will drive the implementation of the strategies. The agencies again examine their existing contracts to identify those that overlap among multiple agencies, that can be awarded most effectively, and that are consistent with the statutes in each jurisdiction. The states determine how to share development of software and equipment in common or pooled-fund contracts and decide whether cooperative purchasing of equipment and hardware can provide consistency and lower-unit costs. The four states may need to handle field installation in their own jurisdictions, given the limitations of state transportation fund sources.
- Integration and verification: Software and hardware components are individually verified and then integrated to produce higher-level application subsystems. These components are also individually verified before being integrated with others until the complete system has been created and confirmed. These tests are typically performed by contractors and sent to the contracting agencies as evidence of successful work.

- System validation: System owners/operators run their own set of tests to make sure that the deployed system meets the original needs identified in the initial system requirements process.
- Operations and maintenance: Each strategy may be operated and maintained through a different method and protocol. For example, if the four states receive grant funding for a truck parking availability system, part of the corridor-wide grant funding may be used to develop common standards and equipment for monitoring parking availability, standards, and designs for roadside DMSs, as well as data architecture and information sharing systems. Each state might then use grant funding to install necessary equipment at each parking facility, along with systems for sharing availability information. Other strategies may need tailored plans for operations and maintenance. The four states will need to determine the best legally authorized opportunities for engaging directly with the private-sector users and/or beneficiaries of these five strategies. The states may decide that the mix of large and small trucking firms is better served in a freight traveler information system that pushes congestion, incident, work zone, and weather restrictions to third-party mapping/routing services and individual company routing systems. States may also decide that the pace of vehicle technological change is so swift that they want to interact directly with individual firms demonstrating new platooning and vehicle automation systems before creating a corridor-wide V2I specification or strategy.

INSTITUTIONAL NEXT STEPS

This planning framework completes Transportation Pooled Fund Study 5-348, the *Interstate-10 Western Connected Freight Corridor*, and identifies strategies to enhance freight operations along the corridor. In addition to fostering the technical advances necessary to develop the strategies, the states along the corridor may need to address a range of institutional issues.

Following the execution of the coalition charter in 2016, the member states developed and executed an operating agreement for the I-10 Corridor Coalition in 2017. This planning framework will enable the states to determine how to collaboratively execute the truck parking information availability system and other strategies. The coalition can identify roles for agency staff, I-10 coalition teams, and contractors.

Figure 4 illustrates a possible structure for deploying the strategies. The structure distributes the tasks by three general organization types: state DOTs, technical consultants, and system integrators. In addition to these institutional issues, strategy implementation is likely to take place in phases over time, with more detailed plans being developed in each phase. The phases, illustrated in Figure 4, are:

- Phase 1—Today: This phase refers to the near-term future, with the completion of the planning framework and the set of strategies. At the same time, the coalition can consider business models by which the four DOTs bring about strategy execution. These address how project funding would be shared, how professional services would be obtained, and how the states may work together in planning and monitoring strategy development.

- Phase 2—Readiness: Once the business model is developed and the coalition governance processes are defined, the DOTs can obtain the services of the systems integrator (SI) described above, along with other technical consultants, to develop plans and specifications for necessary systems. Once the SI is engaged, that firm may proceed with the technical steps necessary to more fully plan for implementing the strategy.
- Phase 3—Build Out: Once the plans are in place for strategy implementation, the DOTs can work with designers to acquire and install the equipment and software, both in the field along the highway infrastructure and in central facilities and control centers. The SI can be expected to work with the DOTs to ensure that local- and regional-level designs and contracts effectively synchronize and communicate as strategies are completed.
- Phase 4—Operations: Once the strategies have been implemented through procedures, systems, communication links, software, and roadside equipment, the DOTs may shift to an operational orientation, ensuring that necessary data are updated and connected. Each DOT may be responsible for ongoing systems support and maintenance.

The I-10 Corridor Coalition member states will determine the pace and means by which these five strategies are deployed as suggested in Table 2 earlier. That process will be set up through plans and agreements yet to come, building on the information used to complete this planning framework.

An illustration of this implementation process can be found in the truck parking grant application filed by the coalition states for funding under the federal Advanced Transportation and Congestion Management Technologies Deployment program. The application is attached as the Appendix and is the next phase of collaborative planning and execution among the coalition states.

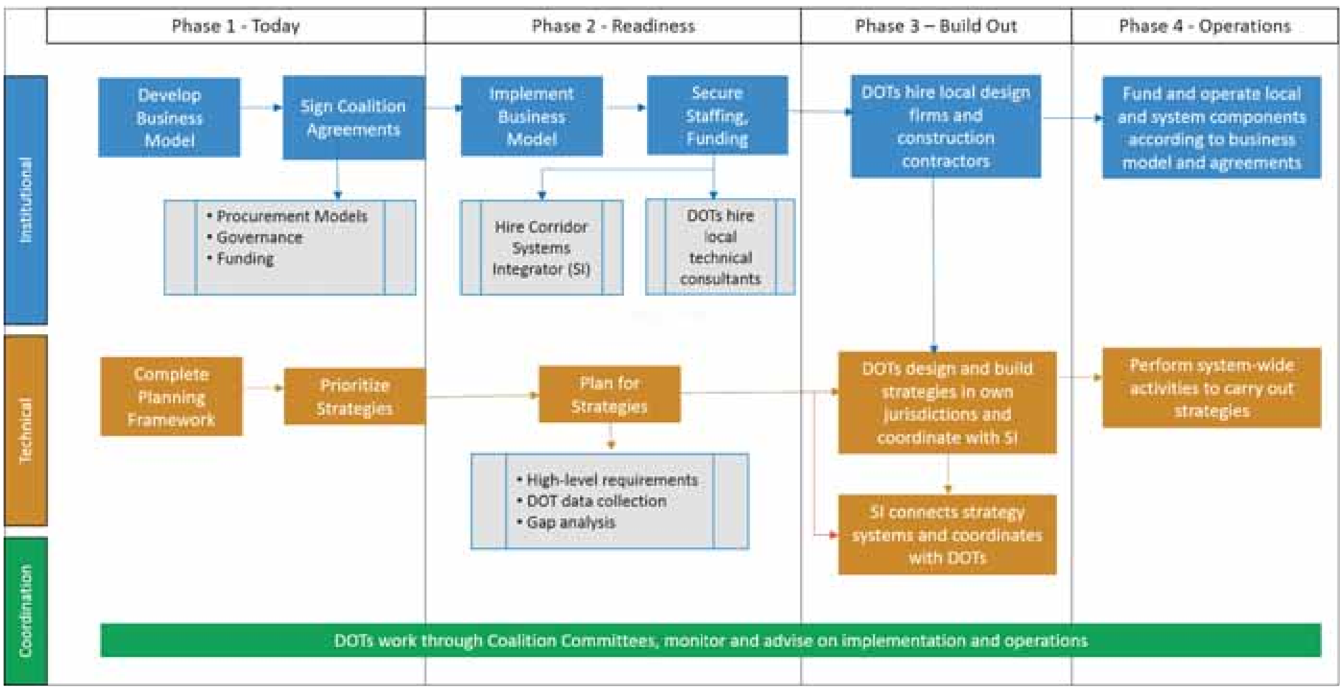


Figure 4. Strategy Implementation Process for Interstate 10 Western Freight Corridor

APPENDIX. I-10 CORRIDOR COALITION TRUCK PARKING AVAILABILITY SYSTEM ATCMTD GRANT APPLICATION

INTERSTATE

10

I-10 Corridor Coalition Truck Parking Availability System

ATCMTD Grant

volume 1 – technical approach

submitted to

U.S. Department of Transportation – Federal Highway Administration

submitted by

Texas Department of Transportation

Advanced Transportation and Congestion Management Technologies Development (ATCMTD) Initiative

Applicant
Texas Department of Transportation

Type of Eligible Applicant
State Agency

ATCMTD Grant Request
$6,850,000

Location
California, New Mexico, Arizona, Texas

Congressional Districts
California (CA 08, CA 27, CA 31, CA 32, CA 33, CA 34, CA 35, CA 36, CA 37, CA 39, CA 40); **Arizona** (AZ 1, AZ 2, AZ 3, AZ 4, AZ 7, AZ 8, AZ 9); **New Mexico** (NM 2); **Texas** (TX 02, TX 07, TX 10, TX 11, TX 14, TX 15, TX 16, TX 18, TX 21, TX 23, TX 27, TX 28, TX 29, TX 36)

NOFO Number
693JJ318NF00010

JUNE 2018

I-10 CONNECTS
I-10 CORRIDOR COALITION

Texas Department of Transportation · Caltrans · ADOT · NMDOT

SECTION I—COVER PAGE

Project Name	I-10 Corridor Coalition Truck Parking Availability System (I-10 Corridor Coalition TPAS)
Eligible Entity Applying to Receive Federal Funding	Texas Department of Transportation (TxDOT)
Total Project Cost (from all sources)	$ 13,700,000
ATCMTD Request	$ 6,850,000
Are matching funds restricted to a specific project component? If so, which one?	No
State(s) in which the project is located	California, New Mexico, Arizona, Texas
Is the project currently programmed in the	
• Transportation Improvement Program (TIP)	No
• Statewide Transportation Improvement Program (STIP)	No
• MPO Long-Range Transportation Plan	No
• State Long-Range Transportation Plan	No
Technologies Proposed to Be Deployed (briefly list)	i. Advanced traveler information systems ii. Advanced transportation management technologies iii. Infrastructure maintenance, monitoring, and condition assessment v. Transportation system performance data collection, analysis, and dissemination systems

TABLE OF CONTENTS

SECTION II—PROJECT NARRATIVE

1. INTRODUCTION

> **Who: The I-10 Corridor Coalition.**
>
> **What:** A **Truck Parking Availability System** (TPAS) including truck parking space utilization and information dissemination technology
>
> **Where: 37 public truck parking facilities on I-10** in California, Arizona, New Mexico, and Texas
>
> **When:** Fully **deployed within 4 years** of Notice to Proceed.
>
> **Why:** This project has a **benefit/cost ratio** of 5.6 at a 3% discount and 4.7 at a 7% discount. Providing truck parking availability information **increases public safety** by reducing fatigue-related crashes with associated **reductions in congestion and delay**, reduced time searching for parking, **reduced emissions and fuel use,** and limits **damage to public highway infrastructure.**

The I-10 Corridor Coalition, whose members comprise the departments of transportation (DOT) of California, Arizona, New Mexico, and Texas and which is supported by the trucking associations of each State, are pleased to submit this application to partner with U.S. DOT on the I-10 Corridor Coalition Truck Parking Availability System (I-10 Corridor Coalition TPAS). Texas Department of Transportation (TxDOT) is the lead applicant and is seeking $6.85 million in 2018 ATCMTD grant funding to implement a truck parking availability detection and information dissemination system at 37 public truck parking locations along the I-10 Corridor from California to the Texas. The objective of this system is to make available to truck drivers and dispatchers in real time truck parking information to assist them in making informed parking decisions. The four States have committed to match the grant 1:1 with other available non-Federal funds or in-kind match to maximize safety, mobility, operational, environmental, and state-of-good-repair elements along the Corridor. These benefits are detailed in this application, and laid out in the Benefit/Cost Analysis (BCA).

> Knowing the number of truck parking spaces that are available at any given time and communicating that information to drivers is the key objective of this project.

Interstate 10 is part of the National Primary Highway Freight System (PHFS). This is a network of highways identified as the most critical highway portions of the U.S. freight transportation system determined by measurable and objective national data. I-10 Corridor is a critical national trade Corridor and the segment from California to Texas connects 4 of the 10 largest U.S. sea ports by tonnage (Los Angeles, Long Beach, Houston, and Beaumont). Under current conditions, drivers frequently waste significant amounts of time looking for a place to park and rest for a required break or at the end of their work day. Drivers who have not found parking before exceeding their Hours of Service (HOS) are often forced to park in unauthorized, unsafe locations such as those shown in Figure 1—highway shoulders, on and off ramps, or on local streets. This lack of adequate, safe truck parking is a national issue that has gained widespread attention in the years following the death of Jason Rivenburg and the subsequent passing of Jason's Law.

The Federal Highway Administration (FHWA) in 2012 noted that 36 State departments of transportation (DOT) reported a lack of commercial vehicle parking. All four States in the I-10 Corridor Coalition—California (Caltrans), Arizona (ADOT), New Mexico (NMDOT), and Texas (TxDOT)—indicated multiple issues, including not enough capacity at public and private rest areas and trucks parking on highway shoulders, interchanges, and on local roads near the highway.

Figure 1: Truck Parking on Ramp,
Texas Canyon Rest Area, AZ

The inclusion of truck parking technology as a funding area in the United States Department of Transportation's (U.S. DOT) 2018 Notice of Funding Opportunity (NOFO) for the Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) grant program provides a great opportunity to address parking needs in the Corridor through the deployment of an I-10 Corridor Coalition Truck Parking Availability System (I-10 Corridor Coalition TPAS). Utilizing proven technology being deployed in Florida and the Mid-America Association of State Transportation Officials (MAASTO) Regional Truck Parking Information Management System (TPIMS). This system will improve mobility and safety along this critical freight Corridor, reduce infrastructure damage and diesel emissions, as well as save commercial truck drivers thousands of dollars a year in lost earnings.[1] The initial deployment described in this grant also can serve as the foundation for future technology implementation in the Corridor, including integration of weather or other alert systems, a truck parking reservation system, and automated and connected vehicle and infrastructure technology.

The I-10 Corridor Coalition is the multijurisdictional group that will oversee this project under the coordination of TxDOT. This Coalition includes four State DOTs (CA, AZ, NM, and TX) that are organized under a charter and operating agreement. The primary objectives of the Coalition are to:

- Explore the technical and operational feasibility of a multijurisdictional I-10 Corridor.
- Develop a model for regional cooperation and interoperability that can be expanded to other States in the southwest U.S. and across the remainder of the I-10 Corridor (Louisiana, Mississippi, Alabama, Florida).
- Support development of technology standards to improve movement of people and freight along the Corridor.

The Coalition is focused on the reconfiguration, expansion, utilization, and integration of intelligent transportation systems (ITS) and connected and autonomous vehicle (CAV) and infrastructure technologies to better accommodate future demand, while increasing efficiency and reliability along the I-10 Corridor.

2. GEOGRAPHIC SCOPE

Through the I-10 Corridor Coalition States, Interstate 10 runs approximately 1,700 miles from the Pacific Ocean and California State Route 1 in Santa Monica, CA to Texas. It is the main east-west link between the Ports of Los Angeles and Long Beach (and the greater Los Angeles region)

[1] American Transportation Research Institute's diary research, released in December 2016, documented the amount revenue lost by drivers who stop driving early in order to find and secure a parking space. With an average of 56 minutes of revenue drive time sacrificed by drivers per day, the parking shortage effectively reduces an individual driver's productivity by 9,300 revenue-earning miles a year, which equates to lost wages of $4,600 annually.

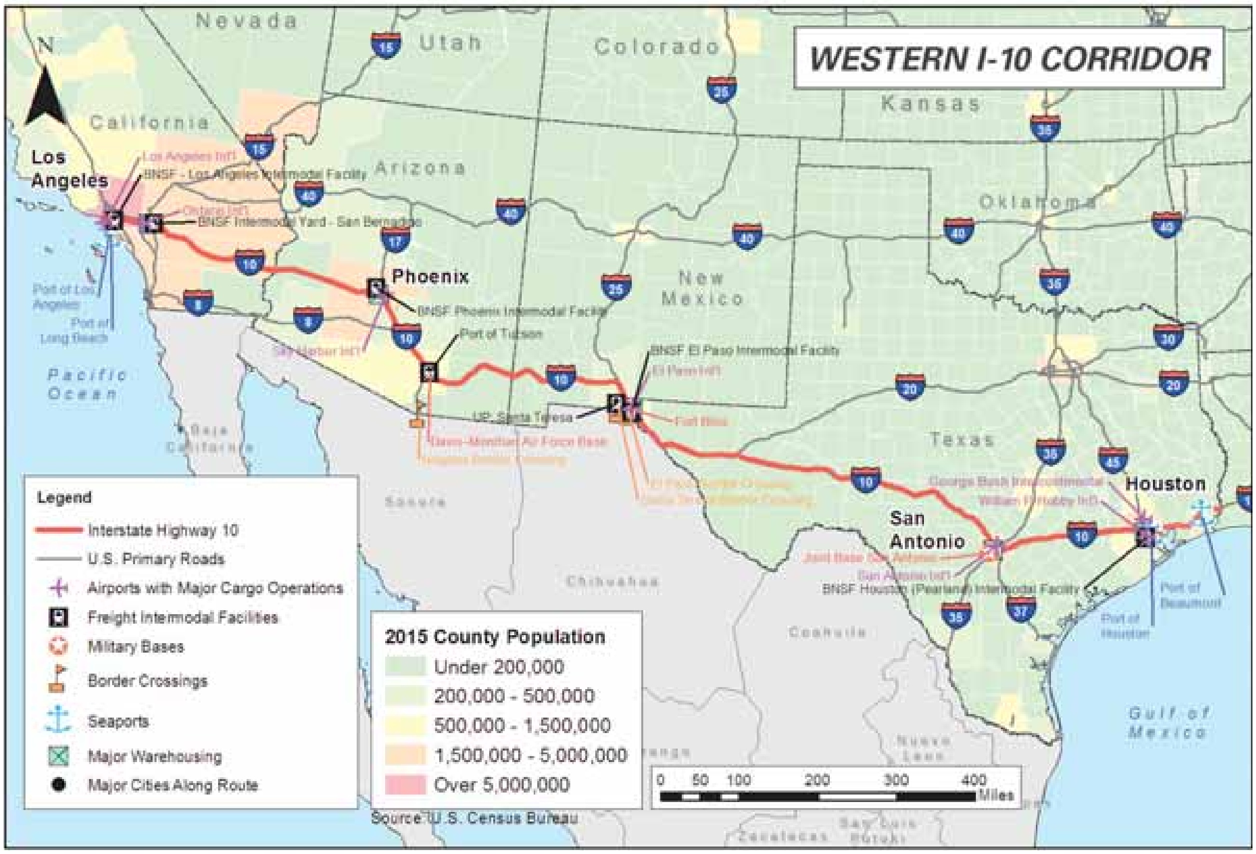
to the Ports of Houston and Beaumont, passing through major metropolitan areas, including Phoenix, Tucson, El Paso, San Antonio, Houston, and Beaumont, and ultimately linking much of the southeastern United States. The Corridor is shown in Figure 2 along with key freight and transportation facilities and intersecting highways.

Table 1: I-10 Mileage by State

California	Arizona	New Mexico	Texas
243 miles	392 miles	164 miles	881 miles

Source: FHWA Route Log and Finder List, 2017. Accessed May 24, 2018.

Figure 2: Project Geography and Key Transportation Facilities



3. ISSUES AND CHALLENGES ADDRESSED

The I-10 Corridor is one of the key economic arteries in the United States, stretching approximately 1,700 miles through the 4 I-10 Corridor Coalition States. On its western end, the Ports of Los Angeles and Long Beach (San Pedro Bay Ports) via Interstate-710 and Interstate-110 are the busiest container ports in the Nation,[2] transferring goods between ships and trucks bound to destinations throughout the country. In Texas, the Port of Houston is the 6th busiest container port in the Nation and the busiest U.S. port by foreign waterborne tonnage and Port of Beaumont, Texas is the 5th largest in the U.S. in terms of annual tonnage and is the #1 military cargo port in the country.[3] Between them, I-10 serves:

[2] https://www.portoflosangeles.org/about/facts.asp. Accessed May 24, 2018.
[3] https://www.portofbeaumont.com/. Accessed May 24, 2018.

- Major metropolitan areas, including Los Angeles, Riverside-San Bernardino, Phoenix, Tucson, Las Cruces, El Paso, San Antonio, and Houston.
- Critical military bases, including Davis-Monthan Air Force Base, Fort Bliss, and Joint Base San Antonio.
- The El Paso International Border Crossing which processed nearly 780,000 inbound trucks in 2017.[4] For numerous other U.S.-Mexico border crossings, I-10 is the first east-west Interstate north of the border.
- Large rail-truck intermodal facilities in each State which provide an alternate option for long-distance shipments.
- Major international airports, including Los Angeles International Airport, Sky Harbor International Airport (Phoenix), and George Bush Intercontinental Airport (Houston).

The communities along the I-10 Corridor are home to businesses that produce and ship goods as well as millions of consumers who depend on stores being stocked with everything from groceries to building supplies to clothes—or want those same items delivered directly to their door.

> The National I-10 Freight Corridor Study estimated the economic impact of freight moving along the I-10 Corridor at $1.38 trillion annually.

The National I-10 Freight Corridor Study examined the economic impact of the entire I-10 Corridor on the economies of California, Arizona, New Mexico, Texas, Louisiana, Mississippi, Alabama, and Florida. The report estimated that freight movement in the Corridor would grow by twice the rate of passenger traffic by 2025. Keeping these trucks moving is critical to support the $1.38 trillion in economic impact the Corridor generates.[5] The 4 States in the I-10 Corridor Coalition greatly benefit from that economic activity, but it comes with a number of challenges.

Freight flows between these States are heavily reliant on trucks to safely and efficiently move goods. Sections of the I-10 Corridor in these 4 States carry more than 26,000 large commercial trucks per day with statewide averages ranging from more than 5,300 combination trucks in New Mexico to nearly 10,400 trucks in California (see Table 2 below). These combination trucks are more likely to be involved in long-distance trade. With longer hours on the road, the need to take rest breaks to meet HOS requirements increases.

Table 2: Combination Truck Average Annual Daily Traffic (AADT), ***2015***

State	Average Truck AADT	Maximum Truck AADT
California	10,398	26,078
Arizona	5,900	8,426
New Mexico	5,382	18,572
Texas	6,358	17,048

Source: Highway Performance Management System (HPMS), 2015.

Approximately 1,270 miles or 75 percent[6] of the total length among the 4 Coalition States are in rural areas. Uncertainty about available spaces is compounded on these long stretches of road with limited amenities and safe places to park where the next stop may be a hundred miles away. The lower truck volumes in these areas combined with sparse population make the business

[4] U.S. Bureau of Transportation Statistics, Border Crossing/Entry Data. Accessed May 24, 2018.

[5] Includes Louisiana, Mississippi, Alabama, and Florida. http://www.firstcoastvision.com/I-10_Freight_Corridor_Study.pdf. Accessed May 24, 2018.

[6] Estimate based on GIS analysis of 2015 National Highway Planning Network data using U.S. Census Urbanized Areas and Urban Clusters.

case for building private truck parking difficult, often leaving the public sector to fill in the gaps and provide this critical amenity. Of the 37 public rest areas selected for I-10 Corridor Coalition TPAS deployment, 33 are in rural areas.[7]

> By making the commercial driver and the truck more productive during their Hours of Service, this project will result in improved benefits to the private-sector freight community, thus enhancing economic competiveness along the I-10 Corridor.

Driving through urban areas in the I-10 Corridor comes with its own set of challenges. Approximately 430 miles (25 percent) of I-10 in the 4 States passes through an urbanized area or urban cluster. Congestion in the Los Angeles-Long Beach-Anaheim, CA metropolitan area cost truck drivers more than $1.25 trillion in 2015 (7th highest in the U.S.) and congestion in the Houston-The Woodlands-Sugar Land, TX metropolitan area cost truck drivers more than $1.15 trillion in 2015 (8th highest in the U.S.).[8] Moreover, interchanges with I-10 are among the worst truck bottlenecks in the country, including interchanges with I-45, U.S. 59, I-610 (west), and I-610 (east) in Houston, TX (#11, #13, #33, and #38 respectively), with I-15 in San Bernardino, CA (#26) and with I-17 in Phoenix (#40) in the top 100.[9] Congestion can force truck drivers to max out their HOS without gaining much distance. In turn, the lack of truck parking in and around urban areas can contribute to congestion by forcing trucks to stay on the road and search for available truck parking spaces.

The combination of long stretches of rural road and high truck volumes in urban areas also increases the potential for crashes. Crashes involving fatigued truck drivers are a particular problem that the I-10 Corridor Coalition TPAS project aims to improve. Data from the 4 States shows an average of nearly 206 truck-involved, fatigue-related crashes a year resulting in 4 fatalities and nearly 70 injuries on I-10.[10]

Figure 3: Truck Parking on Ramp,
Texas Canyon Rest Area, AZ

All of these issues and challenges reinforce the need to provide adequate and safe truck parking for drivers in the Corridor.

Truck parking needs are divided into two categories: **1) A lack of information;** and **2) A lack of supply**. Arizona, New Mexico, and Texas have all recently finished, or are in the process of conducting, truck parking studies to better

[7] Wildwood Safety Roadside Rest Area (EB) in Redlands, CA and Anthony Welcome Center (WB) in Anthony, NM are in urban areas.

[8] http://atri-online.org/wp-content/uploads/2017/05/ATRI Cost-of-Congestion-05-2017.pdf. Accessed May 24, 2018.

[9] http://atri-online.org/wp-content/uploads/2017/01/2017-ATRI Bottleneck-Brochure.pdf. Accessed May 24, 2018.

[10] For Texas, crashes in state database with fatigue as a contributing factor were included. For California, New Mexico, and Arizona, a fatigue-related factor of 13 percent was used consistent with FMCSA statistics. See: https://www.fmcsa.dot.gov/safety/driver-safety/cmv-driving-tips-driver-fatigue. Accessed May 23, 2018.

understand these needs and develop plans to address them within their States. The I-10 Corridor Coalition TPAS directly addresses the first of these needs: a lack of information. Even when truck parking spaces are available in the I-10 Corridor, drivers often do not know where to find them. If a parking area is full, drivers need to know this before arrival in order to develop alternative plans. Knowing the number of available spaces at any given time and communicating that information to drivers is the key objective of this project. In addition, this information can help make informed decisions regarding the need for additional capacity.

The inability for truck drivers to find safe truck parking can result in a number of negative consequences for both public and private-sector stakeholders, including but not limited to:

> There are an average of 206 truck-involved, fatigue-related crashes each year on the I-10 Corridor.

1. Tired truck drivers and those approaching their HOS limits may continue to drive over their limit, increasing risks to public safety. Nationwide, it is estimated that 13 percent of commercial vehicle-related crashes involve a fatigued driver.[11]
2. Truck drivers may choose to park at unsafe locations, such as the shoulder of the road and exit ramps. In addition to the safety risk of parking in these locations, this causes damage to publicly owned infrastructure that is not designed to accommodate heavy trucks.
3. Drivers searching for parking incur costs associated with increased trip miles, vehicle wear, and fuel consumption. This additional driving has negative and costly impacts on highway infrastructure and increases vehicle emissions.
4. Truck drivers may stop driving before reaching their HOS limits in order to secure a space to park. This has a negative impact on productivity with resulting cost penalties to companies and, ultimately, consumers. The American Transportation Research Institute (ATRI) recently estimated that drivers lose an average of 56 minutes a day in driving time due to the need to find parking. This results in a cumulative opportunity cost of approximately $4,600 per driver annually,[12] a figure that may go up as HOS are more actively enforced due to the mandated use of ELDs.

Collecting and disseminating truck parking availability information to drivers will help mitigate these challenges.

Although this project does not directly address the second issue—**truck parking supply**—by providing better information to dispatches and drivers, the project will allow for a more efficient use of existing supply. In addition, a nominal number of spaces may be added during site preparation (e.g., through re-striping or pavement maintenance) associated with the installation of truck parking space utilization technology (discussed further below).

The initial deployment of the I-10 Corridor Coalition TPAS will focus on collecting and publishing truck parking information for public facilities. This will be accomplished through the use of Dynamic Parking Capacity Signs (DPCS), existing State 511 and road information system platforms, and the development of an I-10 Corridor truck parking smartphone application. This application will serve as the base for anticipated future technology deployments in the Corridor (see Section 10) and ensure that information is available to drivers regardless of private-sector involvement. However, as requested, data also will be made available to 3rd party applications and websites to promote widespread use of truck parking availability information.

[11] https://www.fmcsa.dot.gov/safety/driver-safety/cmv-driving-tips-driver-fatigue Accessed May 23, 2018.
[12] American Trucking Associations presentation to I-95 Corridor Coalition (5/2/18).

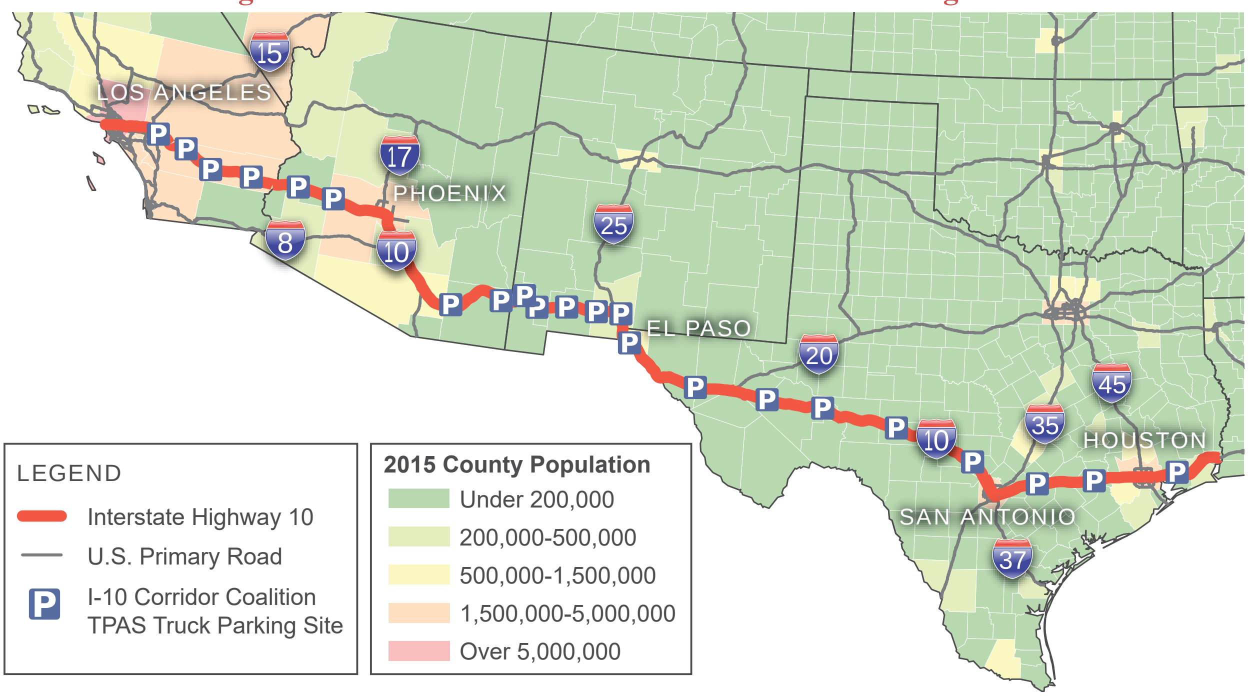
4. TRANSPORTATION SYSTEMS AND SERVICES

> The project has an estimated Benefit-Cost Ratio of 5.6 at a 3 percent discount and 4.7 at a 7 percent discount.

As previously described, the I-10 Corridor through California, Arizona, New Mexico, and Texas is a key strategic artery for commerce in the United States. With some segments of the Corridor carrying more than 26,000 combination trucks a day, providing parking for those vehicles is a critical need. Although some of these vehicles are moving goods a short distance (i.e., from a business to a rail yard or from a distribution center to a store), many are traveling longer distances. While most truck drivers require short-term parking at some point during their trips for food, fuel, or short rest breaks, the larger need for trucks is long-term parking to allow drivers to adhere to HOS rest requirements.[13]

This project is focused on deploying technology to identify truck parking space availability at 37 public truck parking facilities with a total of more than 550 truck parking spaces on the I-10 Corridor (see Figure 4), and disseminating that data to drivers, dispatchers, and public-sector stakeholders through roadside message signs, smartphone applications, and online.

Figure 4: I-10 Corridor Coalition TPAS Truck Parking Sites



This grant application supports deployment of three categories of technology: truck parking space utilization, availability, and information dissemination. Although the following sections describe these separately, the technologies are directly linked. The parking space utilization technology determines the number of available parking spaces and feeds that data to the information dissemination technology, which is then provided to truck drivers and dispatchers.

Truck Parking Space Utilization and Availability

The I-10 Corridor Coalition TPAS project anticipates utilizing two key systems to determine truck parking space utilization and availability—1) a site volume approach using in-ground loop sensors

[13] This parking is usually to meet the 10 consecutive hours off duty requirement. See: https://www.fmcsa.dot.gov/regulations/hours-service/summary-hours-service-regulations. Accessed May 24, 2018.

to measure truck volume entering and leaving a site and 2) a vehicle occupancy detection approach using in-ground magnetic sensors to detect if a space is occupied. The choice of deployment between these two technologies at each truck parking site will be determined through further study conducted after award of grant funding.

Figure 5: Truck Parking in San Antonio, TX with Lined Spaces

Site Volume Approach

The first approach to determining truck parking availability measures site volume, or the number of vehicles entering and leaving the site. By comparing this to the overall number of spaces, an occupancy rate can be calculated.

At sites with the appropriate layout and operating characteristics, this project will utilize loop sensors at the entrance and exit to a truck parking facility to determine the number of vehicles that enter and leave a site. This approach works best at sites with a single truck ingress point and a single truck egress point to avoid counting other vehicles. Loop sensors are a proven technology used by State DOTs to measure traffic volumes in a number of different settings. By comparing the number of trucks that enter and leave the site to the total number of spaces, a utilization rate can be calculated.

This approach can be very cost effective, especially at larger sites where the cost to install a vehicle detection system rises in proportion to the number of truck parking spaces. However, accuracy can be an issue with this approach as there is no way to verify if trucks are actually parking in spaces as opposed to open ground elsewhere in the lot. Additionally, there is limited ability to gather more detailed data, such as the average length of stay, that allows for predictive analytics of truck parking needs. A closed-circuit television (CCTV) feed can be used to baseline the system and check for accuracy but this raises the cost and requires additional human resources to operate.

Other site volume approaches considered include laser detection, Radio-frequency identification (RFID) transponders, and Commercial Mobile Radio Services (CMRS) wireless communication technology. Laser systems are mounted at the entrance and exit to a facility and track volume by counting the number of times the laser beam is broken. The main issue with this approach is accuracy. Adverse weather conditions, including snow, rain, fog, or dust can disrupt the laser beam and lead to a false count. RFID transponders are highly accurate, but only a subset (between 10 and 20 percent) of the national trucking fleet has transponders as of 2018, so obtaining a reliable count is difficult unless the technology is more widely adopted.

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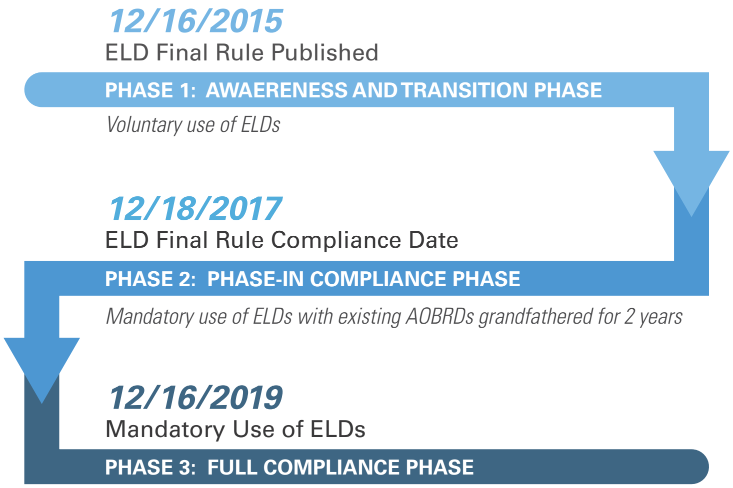
Figure 6: ELD Mandate Timeline



However, electronic logging devices (ELD) which will be mandatory as of December 2019 in most long-haul trucks (see Figure 6), operate using CMRS and have a screen that could display truck parking-related information.[14,15] Future partnerships between ELD manufacturers and the transponder and truck parking application markets could make this technology viable for dual use for both tracking HOS and providing truck parking information.

Parking Space Vehicle Occupancy Detection Approach

The second approach to determining truck parking availability determines occupancy by detecting if a space is occupied. Within this approach there are a number of available technologies, each with their own strengths and weaknesses, as shown in Table 3.

Table 3: Vehicle Occupancy Detection Systems, ***Strengths and Weaknesses***

System Name	Strengths	Weaknesses
In-Ground Sensors	• Widely tested and deployed. • Relatively low cost.	• Accuracy concerns. • Requires facility closure for installation and maintenance.
Video-Detection	• Flexible. • Easy to configure or reprogram remotely. • Low installation and maintenance costs.	• Accuracy issues in inclement weather (snow, rain) and vulnerable to the elements (wind, sun, etc.). • Require interpretation to be effective.
Light and Laser Detection	• Highly accurate.	• Do not classify vehicle types. • High cost to install and maintain. • Vandalism and theft concerns. • Require controlled entry/exit points for the parking area.

Source: North Carolina Truck Parking Study, 2017.

The in-ground sensor node vehicle detection method is well tested and used in deployments throughout the country. Compared to the other vehicle occupancy detection methods, the costs are relatively low. Reliability concerns can be minimized with the deployment of multiple sensors per space (for accuracy weakness) and with planning and public information campaigns (for facility closure). Resulting information, including average length of truck parking occupancy and peak hours, can be used to develop predictive analytics. For these reasons, the in-ground sensor method is one of two specific truck parking space utilization technologies that will be deployed as part of the I-10 Corridor Coalition TPAS project.

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[14] Automatic On Board Recording Devices (AOBRD) satisfy the requirement for the December 2017 deadline. These devices do not have the same display capabilities as an ELD. AOBRD will not meet the requirements after December 2019. See: https://www.fmcsa.dot.gov/hours-service/elds/implementation-timeline. Accessed May 24, 2018.

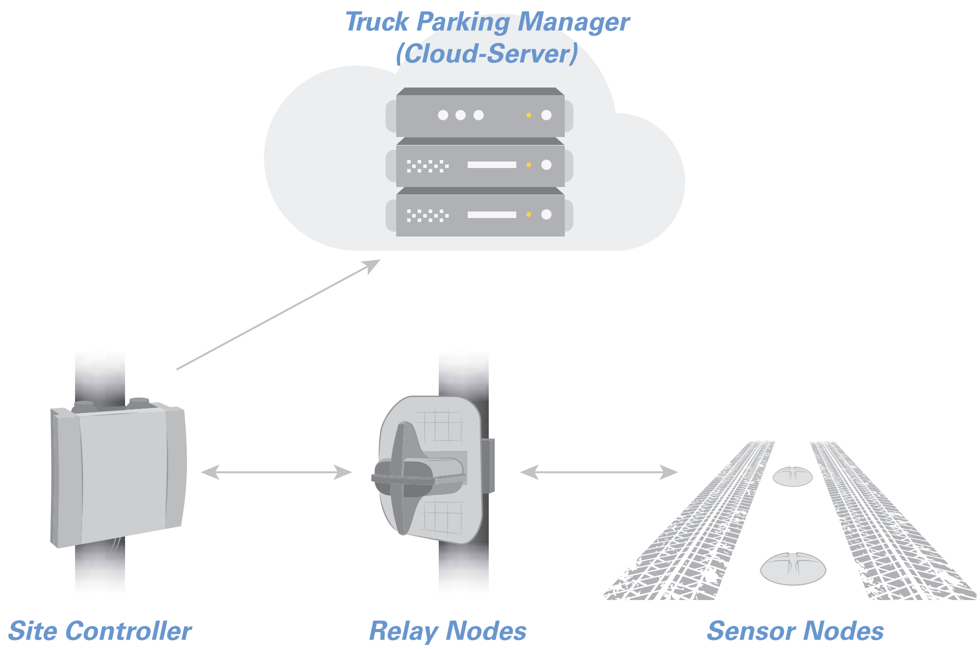
[15] Unlike current transponders used in commercial vehicle bypass systems or electronic tolling which display bypass/pull-in instructions using green and red lights.

This in-ground sensor method requires four key pieces of technology:

- **In-Ground Sensor Nodes:** Wireless, lithium battery (with a life of 7 to 10 years) powered in-ground sensors to determine space occupancy. Two deployed per truck parking space to improve accuracy in detecting smaller trucks.
- **Relay Nodes:** Wireless, lithium battery powered. Attached to poles at site to collect data from sensors. The number required depends onsite layout.
- **Data Collector:** Powered, one per site. Aggregates all data from relay nodes and transmits to a central location for processing.
- **Truck Parking Management System:** Off site. Data processing, performance and system management, and connection to information dissemination system.

The links between these component pieces are shown in Figure 7.

Figure 7: In-Ground Sensor Node Truck Detection System



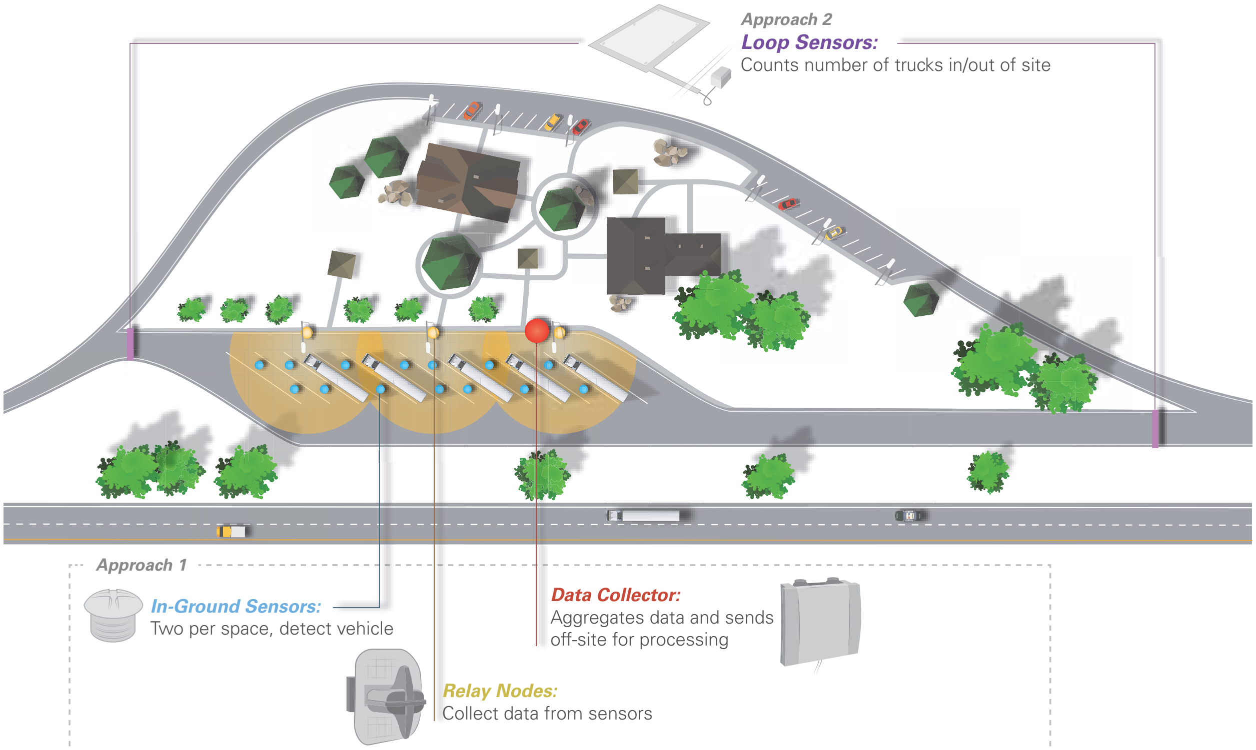
Due to the variety of layouts in the 37 public truck parking locations selected for the I-10 Corridor Coalition TPAS, the two primary approaches will be in-ground magnetic sensors and, where allowed by site layout and operational circumstances, loop sensors. System design will define the appropriate technologies for each of the parking sites.

For the purposes of this application and the benefit/cost analysis, the cost to install in-ground sensors at every truck parking location is used to provide a conservative benefit/cost ratio. For smaller sites (less than 15 spaces), in-ground sensors would be the preferred approach due to lower overall cost than loop detectors, higher accuracy of the system, and ability to deploy at any location, regardless of site geometry or ramp configuration. At larger sites, the loop sensor site volume approach may be more cost effective, but successful deployment is reliant onsite design. Due to this uncertainty, using the more expensive in-ground sensors as the cost baseline for all sites produces a higher cost and a more conservative estimate.

> The Benefit/Cost Analysis assumes the use of in-ground sensors "pucks" at all truck parking sites. This produces a higher overall cost and a more conservative Benefit/Cost Ratio.

Figure 8 below shows a conceptual deployment of the two approaches. Both approaches—Vehicle Occupancy Detection using in-ground sensors (Approach 1) and Site Volume using loop sensors (Approach 2)—are shown in this diagram although.

Figure 8: Space Utilization Technology Approaches



Information Dissemination

Information on the number of available spaces must be combined systemwide and provided to drivers and fleet management staff. There are two main paths for this information dissemination—Dynamic Parking Capacity Signs (DPCS) and smartphone or web-based applications.

Dynamic Parking Capacity Signs

The first approach will place DPCS, shown in Figure 9, upstream from the parking areas. Multiple surveys by ATRI have identified DPCS as the preferred communication method for drivers. The initial grant request would fund two DPCSs approaching each parking location, for those locations serving both eastbound and westbound.[16] The exact location of these signs varies depending on a number of factors, including distance between interchanges, distance between rest areas, and the presence of private parking options. Exact placement will be

Figure 9: Example Dynamic Parking Capacity Sign

[16] There are 37 facilities in the Corridor being considered for this grant. Some serve a single direction of traffic and some have a separate space for eastbound and westbound traffic but are named as a single facility. In total, there are 18 sites eastbound, 17 sites westbound, and 2 sites that serve both eastbound and westbound traffic. This creates a need for 78 DPCS.

determined during the planning and design phase of this project, but best practice around the country is to locate one DPCS within 3 miles of the site and one approximately 20 to 30 miles prior to a site. This provides drivers with an advanced warning of space availability with enough time to consider alternative plans if a location is full and an updated count of space availability as the driver gets closer to the site. The DPCS are anticipated to be similar to that shown in Figure 10. Each sign will include static information showing upcoming truck parking location site names and distance to the site. The number of available spaces displayed on each DPCS will be dynamic and change as information is provided from the space utilization technology.

Figure 10: I-10 Corridor Coalition TPAS Site Information Dissemination Concept of Operations

Smartphone Application and Websites

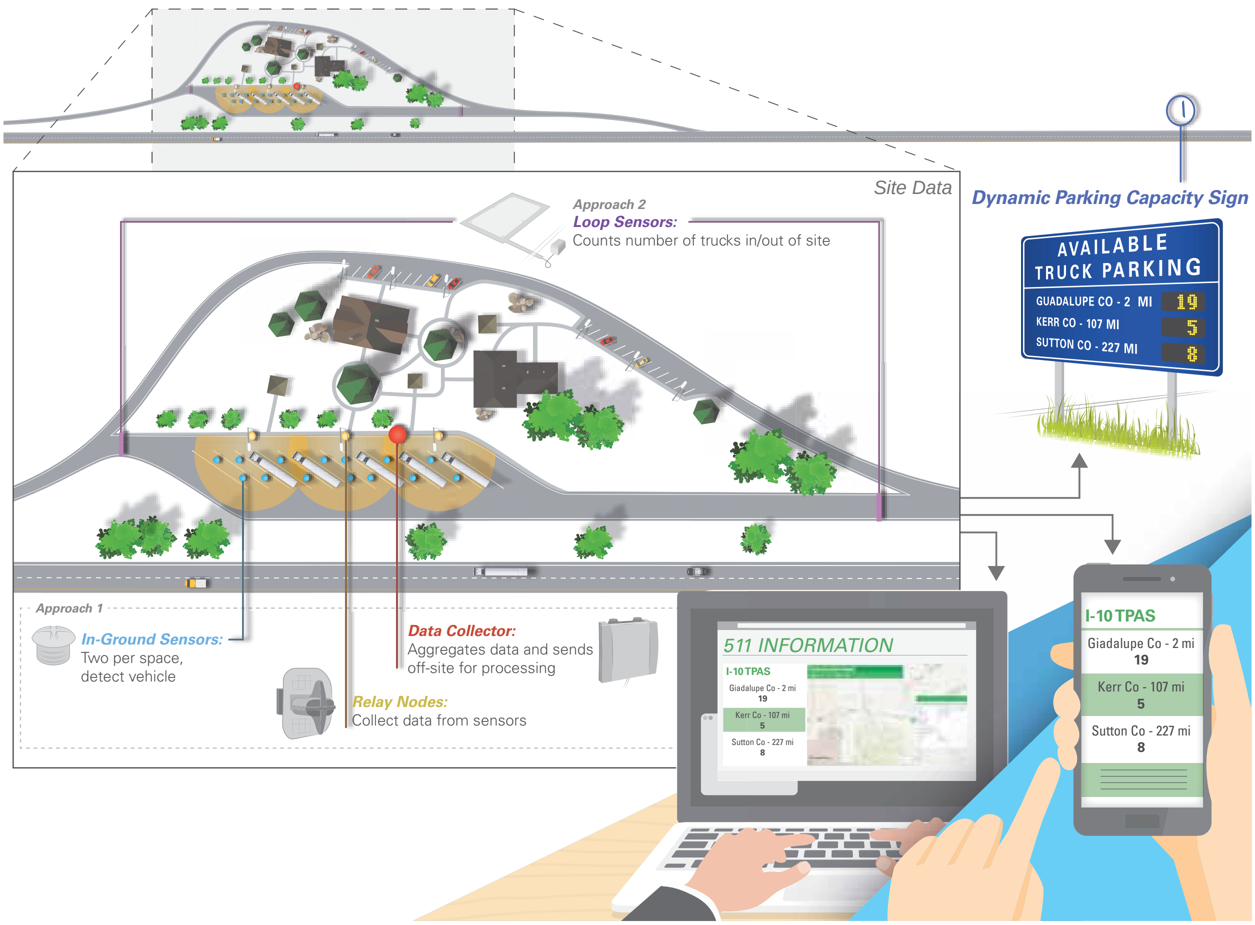
The second information dissemination approach will provide data to drivers and dispatchers via a smartphone application and web-based services. Benefits of this approach include:

- Relatively low cost to implement and minimal marginal cost to add additional users.
- Developing a new smartphone application for truck parking in the I-10 Corridor provides a base for future technology deployments (see Section 10).
- Providing information based on driver-defined preferences, location, and direction of travel.
- Potential integration with ELDs, truck fleet management systems, and privately owned truck parking site information, as well as potential to include a truck parking reservation function.

If developed as a new application by the I-10 Corridor Coalition, the service could be expanded in the future to include privately owned truck stops and serve as the base for additional technology deployments in the I-10 Corridor. Alternatively, the four States could coordinate with existing truck parking applications developers to push truck parking availability to the cloud, for 3rd party applications to acquire. However, this approach requires cooperation from 3rd party vendors which has not yet been obtained. This approach will be explored in further detail in Phase I and Phase II of the Deployment Work Plan (see Section 5).

Combined, the I-10 Corridor Coalition TPAS will collect, analyze, and provide truck parking information to stakeholders as shown in Figure 11.

Figure 11: I-10 Truck Parking Availability System Concept of Operations



5. DEPLOYMENT PLAN STATEMENT OF WORK

A Deployment Work Plan for he ATCMTD I-10 Corridor Coalition TPAS project will be developed upon award of funding but will generally include the following phases and subtasks:

- **Phase I—Planning and High-Level Design**
  - » *Task I-1—Program/Project Management*. The project team will develop a detailed Work Plan, stakeholder engagement plan, and other necessary documents and procedures to guide communications, deliverables, and resolution of issues. This task also includes periodic meetings throughout the period of performance between project team members to ensure the successful deployment of the project.
  - » *Task I-2—Stakeholder Engagement*. The project team will build on the I-10 Corridor Coalition's successful momentum by engaging regional goods movement stakeholders, and signing up additional participants, concentrating on the State trucking associations for the four States. Although placed in Phase I, this subtask will feed other tasks and be ongoing throughout the course of the project.

- » *Task I-3—Define a Concept of Operations (ConOps), Conduct Business Process Mapping, and Refine Data Sources*. Building off of the I-10 Corridor Coalition ConOps now under development (estimated date of delivery: November 30, 2018), the I-10 Corridor Coalition TPAS-specific ConOps will define specific truck parking availability technologies such as sensors at facilities, back office processing, and dissemination of information applications. In parallel, the project team will conduct interviews with trucking association representatives, State agency representatives, and private-sector facilities operators to gather the necessary data to develop a business process map incorporating information and knowledge captured from the new participants.
- **Phase II—Detailed Design and Deployment**
  - » *Task II-1—Define I-10 Corridor Coalition TPAS Requirements.* The project team will develop new user needs Functional Requirements, qualifications for Functional Certification for truck parking information applications, and system requirements to guide the integration between the four State's systems. The project team will capture new requirements from the trucking representatives so that the tool can be customized to maximize usefulness to drivers, trucking companies, and parking facility operators.
  - » *Task II-2—Complete Application Development and Deployment Planning.* The elements of the I-10 Corridor Coalition TPAS overall application will be developed, integrated, coded, and beta tested at a software level under this task. As part of the integration effort, where applicable, the project team will focus on the necessary information exchange with the existing legacy systems that will ensure the I-10 Corridor Coalition TPAS system can be accessed as seamlessly as possible by users as part of their daily business environment (truck drivers, trucking companies, parking facility operators, and State DOTs). The software will be flexibly designed to integrate with a variety of systems and Information Technology (IT) environments, through the use of a cloud-based framework. Additionally, the project team, in consultation with key stakeholders and users, will develop a Deployment Plan which will carefully outline a phased deployment of the system elements, and plans for user training and technical support, system operations, and data collection to support performance measurement.
  - » *Task II-3—System Integration and Deployment.* The project team will instrument 37 truck parking facilities with truck occupancy sensors or loop sensors to measure volume and data processing support, deploy 78 DPCS, integrate the system with each State's transportation management center (TMC) and create an IT platform that will support information exchange with traffic operations centers and their systems (such as 511 and web-based exchange forums), and develop and support a smartphone application to allow drivers to access truck parking availability information. A project team member will be available during the test and deployment periods to assist users in system use, troubleshooting, and requested follow-up training.
- **Phase III—System Performance, Operation, and Maintenance**
  - » *Task III-1—Continuous System Performance Evaluation.* The project team, in collaboration with key stakeholders and users, will develop key performance goals (and supporting measurement metrics) for the system early on, and will continuously measure actual performance of the system during the deployment phase. The project team is prepared to work closely with (and provide data to) an Independent Evaluator, if FHWA decides to provide one.
  - » *Task III-2—Long-Term Operations and Maintenance.* As covered in previous sections of this grant application, this deployment project will enable the I-10 Corridor Coalition

Annual O&M costs for the I-10 Corridor Coalition TPAS are estimated to be $672,000.

TPAS to be scaled beyond the immediate deployment and may include increased truck parking sources, weather advisories, route guidance, and inputs from regional IT initiatives that could impact trucking operations in the Corridor such as the LA Metro FRATIS project and regional connected and autonomous vehicle deployments.

In relation to this longer-term deployment strategy, there are two key operations and maintenance factors: 1) this project will result in the development of a long-term deployment and systems maintenance approach by the State DOT stakeholders; and 2) the anticipated lifespan of the I-10 Corridor Coalition TPAS technology (hardware and software) elements is estimated to be between 10 and 20 years, depending on the equipment. This allows time beyond this 4-year project for the technology to be increasingly well managed and potentially expanded by the stakeholder agencies. An O&M plan will be created to enable the I-10 Corridor Coalition member States in supporting operations and maintenance of the cloud-based I-10 Corridor Coalition TPAS system, including covering costs for hardware and software updates, and replacement of defective units.

As appropriate, these tasks will be guided by the National ITS Reference Architecture (ARC-IT). For ITS projects, the recently released Version 8.1 provides a common basis for planners and engineers with differing concerns to conceive, design, and implement systems using a common language as a basis for delivering ITS projects. It also updated tools such as the Regional Architecture Development for Intelligent Transportation (RAD-IT) which focuses on regional planning and the development of Operations Concepts, and Systems Engineering Tool for Intelligent Transportation (SET-IT) which is a graphical tool for project-focused development.[17]

Throughout the above tasks, the project team will apply rigorous systems engineering principles consistent with Institute of Electrical and Electronics Engineers (IEEE) and FHWA guidance, including, but not limited to the following:

- FHWA Systems Engineering Guidance.
- IEEE Standard 29148-2011—Systems and Software Engineering—Life-Cycle Processes—Requirements Engineering.

6. REGULATORY, LEGISLATIVE, AND INSTITUTIONAL DEPLOYMENT CHALLENGES

There are limited anticipated regulatory, legislative, and institutional deployment challenges associated with deployment of these technologies in the four States. Of note here are three potential challenges that will be addressed:

- **Driver Distraction with In-Vehicle Devices.** Federal Motor Carrier Safety Administration, 49 CFR Parts 383, 384, 390, 391, and 392 [Docket No. FMCSA-2009-0370] RIN 2126-AB22, "Limiting the Use of Wireless Communication Devices" restricts the use of all hand-held mobile devices by drivers of commercial motor vehicles (CMV). This rulemaking restricts a CMV driver from holding a mobile device to make a call or text, or dialing by pressing more than a single button. CMV drivers who use a mobile phone while driving can only use a hands-free phone located in close proximity. This rule impacts how the I-10

[17] Note that Arizona will complete a RAD-IT in Summer 2018 (https://azdot.gov/docs/default-source/transportation-studies/its_architecture_information_brief.pdf?sfvrsn=2). For further information, see: https://local.iteris.com/arc-it/index.html.

Corridor Coalition TPAS mobile application will be designed to minimize driver distraction.

- **Prohibition on Commercialization of Rest Areas on Interstates.**[18] The States of California, Arizona, New Mexico, and Texas recognize that some privately operated truck stops provide a similar service which could in the future be incorporated into an integrated Corridor-wide truck parking information system. However, the initial focus of the I-10 Corridor Coalition TPAS is on the currently noninstrumented public parking locations. This scope will maximize initial benefits and avoid any competitive issues that might arise by inclusion of some private truck-stop operations and not others or by publicly sharing capacity and pricing information.
- **System Design Standards and Technical Specifications.** States may need to adopt or develop design specifications for the associated hardware and software systems that are part of the I-10 Corridor Coalition TPAS to ensure consistency of deployment throughout the I-10 Corridor Coalition. Example specifications for some systems already may be available within the Coalition States. Other specifications can be drawn from other deployments that the I-10 Corridor Coalition TPAS is similar to, including projects in Florida, Michigan, and the MAASTO Regional TPIMS.

7. QUANTIFIABLE SYSTEM PERFORMANCE IMPROVEMENTS

The envisioned I-10 Corridor Coalition TPAS project is anticipated to provide benefits in the areas of safety (crash reduction from searching for parking while fatigued and/or beyond their HOS and parking in unsafe conditions), mobility (reduced travel time savings due to reduced crashes and truck driver time searching for parking), environmental (reduced truck emissions and fuel use), other cost savings (nonfuel vehicle operating costs from reduced miles searching for parking), and state of good repair (reduced wear and tear on roadway ramps and shoulders from illegal truck parking). A quantitative benefit/cost analysis was conducted of the I-10 Corridor Coalition TPAS project to evaluate system performance utilizing the FHWA Tool for Operations Benefit Cost Analysis (TOPS-BC) and other spreadsheet methods. It provides estimates for benefits of the project in terms of travel-time savings, accident cost savings, environmental (emissions and fuel) cost savings, and other cost savings (vehicle operating costs). The Excel Worksheet containing the benefit/cost analysis can be provided to the U.S. DOT upon request and is summarized in Appendix C.

Table 4 presents the expected annualized monetary benefits from the benefit/cost analysis results.

Table 4: Summary of I-10 Corridor Coalition TPAS Project Average Annual Benefits, *$ Millions*

System Name	Safety	Travel Time	Environmental	Operating	Total
Annual Monetary Benefit	$4.7	$1.0	$1.1	$1.3	$8.1

It is important to note that there are other expected system benefits from the I-10 Corridor Coalition TPAS project which were not quantitatively assessed as part of the analysis. For example, reducing crashes associated with fatigued drivers will improve travel-time reliability and overall economic competitiveness for the freight industry along the Corridor. Safety and state-of-good-repair (pavement) benefits from trucks utilizing available parking at rest areas instead of ramps, neighborhood streets, or other potentially unsafe locations. Finally, providing a better truck parking environment frees enforcement personnel to focus efforts on other issues.

[18] https://www.federalregister.gov/documents/2016/09/27/2016-23269/commercial-activities-on-interstate-rest-areas.

Based on an average annual cost of $1.27 million, **the benefit/cost for the I-10 Corridor Coalition TPAS project is estimated to be 6.3 undiscounted, 5.6 at a 3 percent discount, and 4.7 at a 7 percent discount.**

8. QUANTIFIABLE SAFETY, MOBILITY, AND ENVIRONMENTAL BENEFITS

Based on the benefit/cost analysis performed and summarized in Section 7, Table 5 presented the quantified safety, mobility, and environmental benefits estimated for the project.

Table 5: Summary of I-10 Corridor Coalition TPAS Project Safety, Mobility, and Environmental Benefits

Benefit Type	Estimated Benefits
Safety	• Implementation of the I-10 Corridor Coalition TPAS is estimated to reduce the number of fatigue-related commercial vehicle crashes by 10 percent resulting in approximately 21 fewer fatalities, injuries, and PDO crashes annually which corresponds to a $4.7 million annual savings.
Mobility	• The estimated delay saved from the fatigue-related crashes above and subsequent lane closures is 20,000 hours annually, resulting in $278,000 in annual savings. • Over 27,000 hours are estimated to be saved annually by truck drivers from the truck parking availability information via the truck parking capacity signs and the web application. This equates to approximately $740,000 in annual mobility savings.
Environmental	• Emissions and fuel use savings will result from the reduced number of miles trucks will drive from searching for parking. The benefit/cost analysis approach assumed a 15-minute savings which corresponds to 12 miles and 2 gallons saved per parking space utilized. CO_2 savings is estimated to be nearly 2,500 tons or $90,000 annual savings. Other emissions savings are estimated to be nearly $300,000 annually from CO, NOx, VOC, $PM_{2.5}$, and PM_{10}. Fuel savings from the truck parking information is estimated to be 221,000 gallons annually, $672,000 annually. An additional $36,000 is saved annually associated with CO_2, fuel use, and other emissions from savings associated with the fatigue-related crashes.

9. DEPLOYMENT VISION, GOALS, AND OBJECTIVES

Interstate 10 and is a critical artery for the movement of freight that drives economic activity in California, Arizona, New Mexico, and Texas. Recognizing the importance of collaborating on activities that impact I-10, these four States formed the I-10 Corridor Coalition in 2016 with the goal of working together to create safer and more efficient travel, both commercial and personal, along the Corridor. The vision, goals, and objectives of the I-10 Corridor Coalition TPAS, shown in Table 6 below, align with and will support the overarching I-10 Corridor Coalition goal.

Table 6: I-10 Corridor Coalition TPAS Vision, Goals, and Objectives

Vision: Truck drivers, dispatchers, and public officials in the I-10 Corridor will have real-time access to accurate and reliable information about public truck parking availability through an advanced, coordinated, and intelligent transportation information system.	
Goals	**Objective**
Reduce fatigue-related truck-involved crashes in the I-10 Corridor.	The I-10 Corridor Coalition TPAS will enable commercial vehicle drivers to readily identify parking spaces and reduce the chances of operating while fatigued.
Reduce emissions associated with excess driving while searching for parking.	The I-10 Corridor Coalition TPAS will enable commercial vehicle drivers to readily identify parking spaces and reduce travel searching for parking.
Reduce public infrastructure degradation from vehicles parking in unauthorized locations.	The I-10 Corridor Coalition TPAS will enable commercial vehicle drivers to readily identify parking spaces and reduce parking along highway shoulders, ramps, or other unauthorized locations.
Create an information technology platform that can be expanded in future deployments to serve other Corridors within the four States, other States along I-10, and/or other ITS needs in the I-10 Corridor.	The I-10 Corridor Coalition TPAS will create a system that can be expanded elsewhere in the member States, possibly expanded to adjacent States, and could be leveraged to deliver other truck-related travel information such as forecasted truck availability or weather advisories.

A successful deployment of the I-10 Corridor Coalition TPAS project will identify vacant truck parking spaces and communicate that information in real time to drivers, dispatchers, public officials, and other stakeholder in I-10 Corridor using a variety of information dissemination systems. The information systems developed during this project such as a smartphone application, could be expanded both within the I-10 Corridor Coalition member States to other important Corridors (or even statewide) and to other States I-10 passes through (Louisiana, Mississippi, Alabama, and Florida).

10. LEVERAGING LOCAL AND REGIONAL TRANSPORTATION TECHNOLOGY INVESTMENTS

There are a number of local and regional ITS projects that will provide a structure or input for the I-10 Corridor Coalition TPAS. The key systems are described in the sections below.

I-10 Western Connected Freight Corridor Concept of Operations (Pooled Fund Study)

For the State DOTs for California, Arizona, New Mexico, and Texas, Texas A&M Transportation Institute (TTI) and a team of consultants is leading the development a ConOps report for an I-10 western connected freight Corridor, to be completed by December 2018. Through the ConOps, this project is creating a framework for future improvements in technology, governmental policies, and procedures that will create a better environment for shippers and carriers doing business along the I-10 Corridor. This project's objectives include harmonizing transportation standards across State lines and facilitating successful deployment of technologies and applications for commercial vehicle movement along the Corridor. The ConOps is focusing on the following five technical areas:

- Advanced Freight Traveler Information System.
- Truck Parking Availability Systems (TPAS).
- Roadside Safety Communication.
- Permitting Standardization.
- Truck platooning.

It is important to note that the TPAS element of the ConOps is fully consistent with the approach to the I-10 Corridor Coalition TPAS being presented in this proposal.

Texas Connected Freight Corridors Project

Texas Department of Transportation is leading the Texas Connected Freight Corridors Project to create a sustainable connected vehicle deployment in Texas using I-35, I-10, and I-45 to showcase connected vehicle applications applicable to TxDOT and its partners throughout the "Texas Triangle." The project, partially funded through a $6.09 million 2017 ATCMTD grant to Texas DOT. TxDOT and the project partners will match the grant with at least $6.1 million making the total project cost over $12 million.

The project will utilize a combination of technologies, including cellular, Dedicated Short-Range Communications (DSRC), and smart infrastructure to implement a suite of vehicle-to vehicle (V2V) and vehicle-to-infrastructure (V2I), collectively called V2X applications. These technologies are expected to enable a sustainable deployment where TxDOT will be able to acquire a rich set of traffic conditions data and in turn provide better information to its freight partners and the traveling public. For example, the I-35 Connected Work Zone (CWZ) pilot provides congestion and construction information directly to cellular communication equipment in long-haul trucks. Another element of the model deployment effort will accommodate Truck Parking Reservations.

The Texas Connected Freight Corridors Project provides opportunity to support the goals of the proposed I-10 Corridor Coalition TPAS by potentially exchanging information related to parking availability along I-10, I-35 and I-45 in the "Texas Triangle."

New FRATIS—Port of Los Angeles/Long Beach

In the future, I-10 Corridor Coalition TPAS and the Freight Advanced Traveler Information System (FRATIS) program in Los Angeles will be able to exchange information so that intermodal trucks could stage parking out of the Los Angeles area overnight to better manage the flow of trucks into the ports of Los Angeles and Long Beach. With significantly expanding levels of imports and exports through the ports, this would represent a regional approach to managing not only current, but future congestion at the west coast ports and along the I-10 Corridor connecting the ports.

State and Regional Traveler Information Systems

State 511 Deployment

511 is described by the U.S. DOT as "America's Traveler Information Telephone Number."[19] This free phone service provides access to travel information that varies by State or region but, at a minimum, includes traffic and road conditions. Many States or regions also have deployed a companion website to support the 511 service. State-level 511 deployment as of July 2016 in the I-10 Corridor Coalition States is summarized in Table 7.

Table 7: Online State 511 System Overview

System Name	Safety	Travel Time	Environmental	Operating
Deployed Statewide	Regional deployment, overseen by Caltrans	Yes	Yes	On State highways[b]
Traffic	Yes	Yes	Yes	Yes
Events/Construction	Yes	Yes	Yes	Yes
Weather	No	Yes	Yes	Yes
Road Work	Yes	Yes	Yes	Yes
Truck-Specific Information[a]	No	No	No	No
Transit	Yes	No	No	No

[19] https://www.fhwa.dot.gov/trafficinfo/511what.htm.

System Name	Safety	Travel Time	Environmental	Operating
Website	https://go511.com/ http://www.ie511.org	http://www.az511.gov	http://nmroads.com	https://drivetexas.org

[a] Includes truck size and weight restrictions, information about weigh stations, parking, etc.
[b] Dallas-Ft. Worth has a regional 511.

Regional Traffic Management Center (TMC) Deployment

Additional resources are available at the local and regional level through Traffic Management Centers (TMC). TMC use ITS to collect data and provide information to motorists in key locations along I-10, including San Antonio (TransGuide), Houston (TranStar), and Los Angeles (RIITS).

Connected and Autonomous Vehicle Testing

Connected and Autonomous Vehicle (CAV) testing on the I-10 Corridor already is underway. Embark began a pilot test between El Paso, TX and Palm Springs, CA in October 2017 using CAV with a human in the cab. Human drivers bring a trailer from the shipper to a rest stop off I-10 where the CAV takes over and delivers the trailer to another rest stop for final delivery by another human driver. Although there is no in-ground infrastructure associated with this test as of writing this report, the existence of a pilot CAV program in the Corridor may provide future synergies with the I-10 Corridor Coalition TPAS deployment.[20]

11. PROJECT SCHEDULE AND DELIVERABLES

The proposed I-10 Corridor Coalition TPAS Project can be completed within four years from notice to proceed. Since the proposed project is an ITS project, it will follow the Systems Engineering process. Once the software development is completed and equipment has been purchased construction of the proposed project can begin. There will be no right-of-way acquisition required for the proposed project. The project schedule is provided in Table 8.

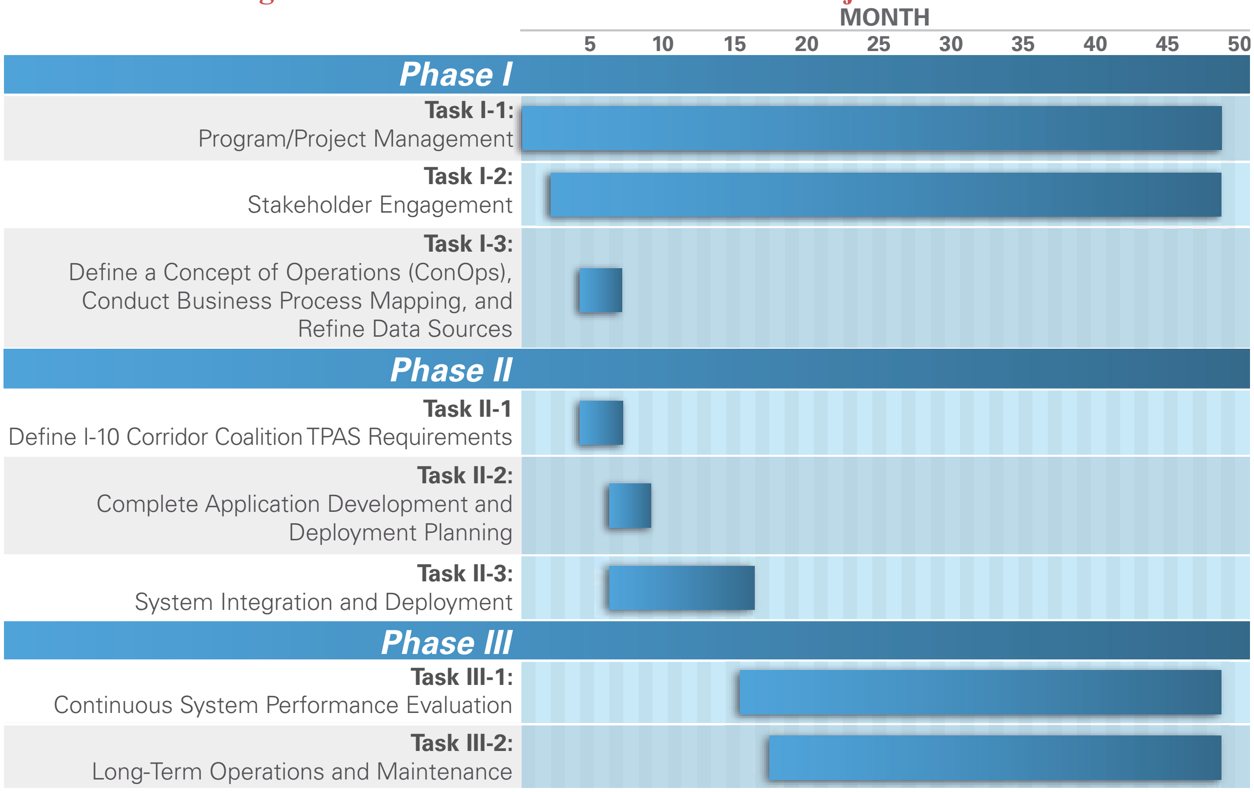
Table 8: I-10 Corridor Coalition TPAS Project Schedule

Activity or Milestone	Duration	Completion Date—Months after NTP
Kickoff Meeting	**1 day**	**1 month**
Procurement	3 months	3 months
Concept of Operations and Stakeholder Outreach	3 months	6 months
User Needs, Functional and System Requirements	2 months	7 months
Design	2 months	9 months
Year 1 Report to the Secretary	**2 weeks**	**12 months**
Software Development	5 months	14 months
Equipment, Communication, Field Installation	2 months	16 months
Testing, Integration, Validation	2 months	18 months
System Operations	14 months	48 months
Year 2 Report to the Secretary	**2 weeks**	**24 months**
Year 3 Report to the Secretary	**2 weeks**	**36 months**
Year 4 Report to the Secretary	**2 weeks**	**48 months**
Monthly Progress Reports	**1 day**	**Every month**

The Gantt chart in Figure 12 presents the project tasks detailed in Section 5 and their timeline.

[20] https://www.wired.com/story/embark-self-driving-truck-deliveries/. Accessed May 29, 2018.

Figure 12: I-10 Corridor Coalition TPAS Project Timeline



12. LEVERAGING U.S. DOT ITS AND TECHNOLOGY PROGRAMS

U.S. DOT has deployed a number of Intelligent Transportation Systems (ITS) and technology programs that can help guide the deployment of the I-10 Corridor Coalition TPAS or be included in the I-10 Corridor Coalition TPAS system in the future once the base system is complete. These systems and their interaction with the I-10 Corridor Coalition TPAS elements are shown in Table 9 below.

Table 9: I-10 Corridor Coalition TPAS and U.S. DOT ITS and Technology Programs

I-10 Corridor Coalition TPAS Element	U.S. DOT Program	Leverage Point
Truck Parking Space Utilization Detection Technology	• SmartPark	• FMCSA program demonstrated technology to provide truck parking availability information in real time. Lessons learned have influenced development of private-sector technology and choice of detection systems in this grant.
Information Dissemination (website/ smartphone application)	• Freight Advanced Traveler Information System (FRATIS) • ITS Joint Programs Office (ITS-JPO) Emerging Capabilities (Private-Sector Coordination) • ITS Joint Programs Office (ITS-JPO) Enterprise Data	• The real-time traveler information and dynamic route guidance pieces of the FRATIS program are commonly included in vehicle navigation and traffic routing software today. • ITS-JPO Emerging Capabilities examines and ensures the safe adoption of new and advanced technologies in the transportation field. » Includes close interaction with private sector and academia to identify promising new technologies. • ITS-JPO Enterprise Data develops mechanisms to capture, house, share, analyze, transport, and apply operational data to improve safety and mobility across all modes of transportation.

I-10 Corridor Coalition TPAS Element	U.S. DOT Program	Leverage Point
All technology components	• Smart Roadside Initiative (SRI)	• One of the key research goals of the SRI program is to ensure that the necessary standards, protocols, and architecture are developed to support both interoperable operations across the country and appropriate data privacy requirements.
Funding	• Innovative Technology Deployment (ITD) Program	• FMCSA program focused on improving commercial motor vehicle safety. 2018 NOFO includes truck parking as a funding area. » "Projects associated with this priority should demonstrate real-time dissemination to a CMV driver of truck parking space availability information based on using: DPCS, interactive voice recognition, smartphone app, or other proven technology."
Future Information Dissemination	• Wyoming I-80 CV Pilot	• Potential to leverage I-80 technology deployments once the initial I-10 Corridor Coalition TPAS deployment is complete. » Weather Information: Dust storms and occasional severe flooding are weather conditions that impact travel on the I-10 Corridor. » Process to develop a standard set of practices and a shared agreement about roles and responsibilities for deployment and managing the CV program for I-80 will be applicable for future deployment on I-10.

13. PROGRAM TECHNOLOGIES, GOALS, FOCUS AREAS, AND OBJECTIVES ADDRESSED

The overall goal of the proposed project is to improve safety, reduce emissions from trucks searching for parking and mitigate impacts on roadway infrastructure from trucks parking in unauthorized locations on the I-10 Corridor. This is done by gathering accurate and reliable information about public truck parking availability and providing real-time access to such information via Dynamic Parking Capacity Signs and/or other applications.

The I-10 Corridor Coalition TPAS project furthers four program technologies, 10 U.S. DOT goals, one focus area, and four departmental objectives defined in the NOFO as shown in Table 10.

Table 10: I-10 Corridor Coalition TPAS Technologies, Goals, Areas, and Objectives Addressed

Topics Addressed	I-10 Corridor Coalition TPAS Project Explanation
Technology	
i. Advanced traveler information systems	• Utilizing proven technology, this project will provide real-time truck parking information at public rest stops based on data from sensors allowing truckers to make informed decisions. This information will be publicly available on agency websites, via an app, and on roadside DPCS.
ii. Advanced transportation management technologies	• With four States in the I-10 Corridor Coalition, this project will use advanced data collection and processing from sensors to assist transportation agencies with interjurisdictional coordination to provide real-time, dynamic parking availability information to improve mobility and safety along this critical freight artery.

Topics Addressed	I-10 Corridor Coalition TPAS Project Explanation
iii. Infrastructure maintenance, monitoring, and condition assessment	• The technologies proposed for this project will aid the transportation agencies in the four States to better monitor and manage truck parking at public rest areas and prioritize areas where additional resource allocation may be needed (e.g., additional paved areas for marked truck parking, future truck parking reservation needs, etc.).
iv. Transportation system performance data collection, analysis, and dissemination systems	• This initial project deployment is intended to set the foundation for future technology implementation in the Corridor. Information and data obtained from these technologies can be used to conduct analyses, research and identify and prioritize other improvements in the Corridor.
U.S. DOT Goals	
Enhanced use to existing capacity	• Providing information on available parking spaces will increase utilization of existing truck parking capacity at the public rest stops.
Delivery of environmental benefits	• The I-10 Corridor Coalition TPAS project is estimated to reduce CO_2 emissions by nearly 2,600 tons annually, equating to $93,000 saved annually. Other emissions savings are estimated to be $307,000 annually from CO, NOx, VOC, $PM_{2.5}$, and PM_{10}. Fuel savings from the truck parking information is estimated to be 228,000 gallons annually, $694,000 annually.
Improvement in operational performance	• As discussed previously, this system will improve both mobility and safety. Truck drivers searching for parking incur costs associated with increased trip miles, vehicle wear, and fuel consumption. Reducing fatigue-related truck crashes will improve the operational performance and reliability of the transportation networks.
Reduction in number and severity of traffic crashes	• The project will enhance safety by reducing the number of fatigue-related incidents, smoothing traffic flow, and reducing queue lengths resulting in an estimated savings of $4.7 million annually from reduced crashes.
Collection, dissemination, and use of real-time transportation-related information	• Traveler information from CMSs and the I-10 Corridor Coalition TPAS app will provide truckers with easier access to improved and expanded truck parking information in real time or for travel planning improving mobility, more efficient truck travel, reduced infrastructure damage, and improved safety.
Monitoring transportation assets to improve and prioritize investment decisions	• The truck parking availability technologies will provide the four DOTs with added ability to monitor their investments and prioritize truck parking investments in the Corridor as they will have better information on utilization and demand. In addition, if truck drivers are unable to find available parking, they may choose to park at unsafe locations, such as the shoulder of the road and exit ramps causing additional damage to publicly owned infrastructure not designed to accommodate heavy trucks. This project would reduce these impacts.
Delivery of economic benefits	• The estimated Benefit/Cost ratio for the I-10 Corridor Coalition TPAS project is 6.3 undiscounted, 5.6 at a 3 percent discount, and 4.7 at a 7 percent discount. The improved safety, mobility, and reliability benefits from improved traveler information will improve goods movement operational efficiencies and shipping costs, thereby providing economic benefit. Without this information, truck drivers may stop driving before reaching their Hours of Service (HOS) limits in order to secure a parking space because of the uncertainty of available spaces further along their route. Knowing the availability of parking can improve productivity.

Topics Addressed	I-10 Corridor Coalition TPAS Project Explanation
Integration of technologies into TSM&O	• A Concept of Operations report is being developed for the I-10 Western Connected Corridor Coalition, to be completed by December 2018. This project would serve as the foundation for future technology implementation by the Coalition in this high-priority connected freight Corridor. Other technologies under consideration include integration of weather or other alert systems, a parking reservation system, long-haul truck platooning, connected vehicle roadside safety infrastructure, and autonomous trucks to improve transportation system management and operations in the Corridor.
Evaluation of the impacts of project technologies	• The I-10 Corridor Coalition TPAS improvements would reduce the amount of time truckers drive around looking for parking and illegal parking on freeway ramps, shoulders, or neighborhoods along the Corridor resulting in reduced emissions, fuel use, and noise impacts.
Reproducibility and knowledge transfer	• Data and information obtained from this project could be used to assess the applicability of truck parking availability technology in other locations or Corridors.
Focus Areas	
Rural technology deployments	• The I-10 Corridor Coalition TPAS technology is mostly a rural deployment as the majority of the public rest areas through the four States are located in rural areas.
Objectives	
Supporting economic vitality	• Improving goods movement efficiencies and productivity from improved truck parking information along the four State high-priority freight Corridor will promote economic vitality at both the national and regional level.
Leveraging Federal funding to attract other, non-Federal infrastructure investment	• Leveraging Federal funding for advanced technologies in the Corridor provides the opportunity to utilize State funds for other investments in the Corridor. In this case, to also help identify where additional resources should be used to increase parking capacity at rest areas that show need based on real data.
Using innovative approaches to improve safety	• The project represents an innovative approach to providing real-time truck parking information both on DPCSs and an app which will reduce fatigue-related truck crashes thus improving safety in the Corridor, as well as improving goods movement productivity.
Performance accountability and achieving measurable outcomes	• The I-10 Corridor Coalition will monitor and evaluate the effectiveness of the I-10 Corridor Coalition TPAS to ensure the project is achieving the goals and outcomes identified.

SECTION III—MANAGEMENT STRUCTURE

1. PROJECT ORGANIZATION DESCRIPTION

The Texas Department of Transportation is the designated recipient that will enter into this agreement with FHWA and is the organization that will receive the federal funding. The department was established in 1917 by the Thirty-fifth Texas Legislature. The department, headquartered in Austin, maintains eighteen functional divisions, twenty-five district offices, and has approximately 25,000 employees. The chief duties of the department are to delineate, build, and maintain all state highway and public transportation systems.

This program will be managed by TxDOT's Freight and International Trade Section within the Transportation Planning and Programming Division. Mr. George J. Villarreal, P.E., TxDOT, will be the overall Program Manager for this project and will be the single point-of-contact for U.S. DOT for this grant. As detailed in Section IV (Staffing Description), Mr. Villarreal is a seasoned manager of major programs at TxDOT.

As presented in the Organizational Chart in Section IV, each state DOT (CA, AZ, NM, and TX) will provide a "State Project Lead" that will be responsible for managing development and deployment elements of the TPAS for their respective states. Each State Project Lead (including a State Project Lead for TxDOT as well) will report directly to Mr. Villarreal.

Coordination among the four State Project Leads to develop and deploy the ATCMTD technologies under the overall direction of Mr. Villarreal will be conducted in an organized manner that will be seamless to U.S. DOT – U.S. DOT staff will only need to coordinate grant management activities with Ms. Mays at TxDOT. To facilitate this streamlined management approach, a charter and operating agreement have been signed and implemented by the four states:

- The four states recently completed and signed an ATCMTD TPAS Joint Project Agreement that specifically outlines the financial, operational and management responsibilities of the each state to support the successful deployment of this project for U.S. DOT; it may be reviewed online here:
- The I-10 Corridor Coalition Organizational Charter may be reviewed online here: https://i10connects.com/sites/default/files/documents/files/organizational-charter-i10-Corridor-coalition.pdf.
- The I-10 Corridor Coalition Operating Agreement may be reviewed online here: https://i10connects.com/sites/default/files/documents/files/I-10_Corridor_Coalition_Operating_Agreement_AZ-NM-CA-TX_FINAL-12-19-2017.pdf.

As detailed in Section IV, a Systems Engineering Team contractor is already in place to support development of the Year 1 activities of stakeholder outreach, development of the Concept of Operations, System Requirements, and High-Level System Design. This activity will support TxDOT in proceeding early in Year 2 with the procurement of the System Implementation Team Contractors, who will proceed with Final Design, Technology and Software Development, Beta Testing, Deployment, and two years of System Operations – across the four states, in coordination with the State Project Leads, but under the project-level management of Mr. Villarreal at TxDOT.

2. PARTNERSHIP PLAN

The trucking industry, particularly, truck drivers, but also secondary users who assist in truck trip planning (e.g. trucking dispatchers, fleet managers, shipping companies), are the primary end users of the TPAS system. To facilitate substantial trucking industry private sector involvement in this project, as detailed in the organizational chart (Section IV), leadership from the four state trucking associations (CA, AZ, NM, TX) will serve as valuable private sector advisors throughout this project, and will be providing access to trucking companies to help implement a User Advisory Group, which will be periodically engaged in this project to validate the deployed applications are delivering the intended benefits to truck drivers operating on I-10. Each of the four states trucking associations have pledged support to facilitate these activities; their Letters of Support are **provided in Appendix B**.

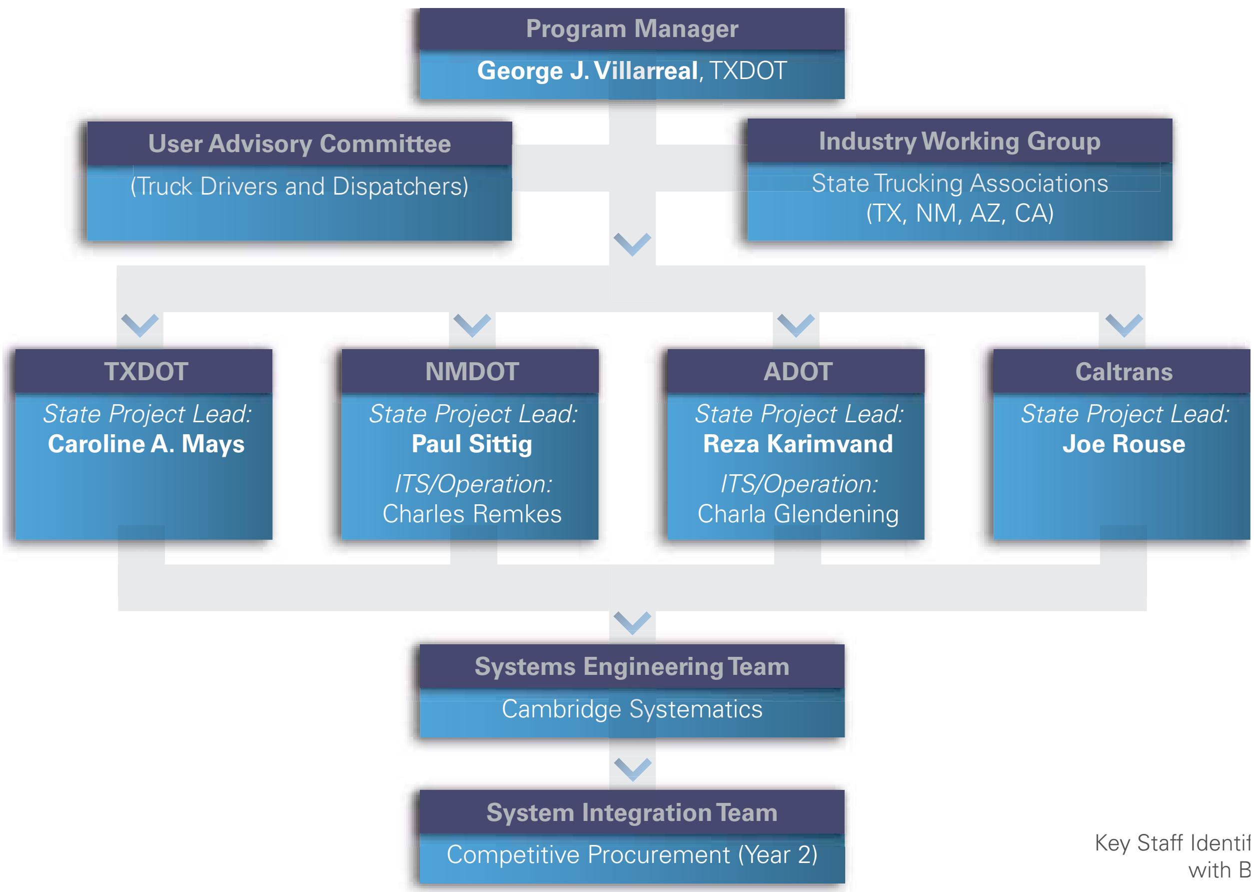
3. DESIGNATION OF SUB-RECIPIENTS

TxDOT is the only agency that will receive funding directly from U.S. DOT for this project. However, TxDOT will use the funds for procuring a contractor for deploying and operating the system in Texas and in the three other I-10 Corridor Coalition states: California, Arizona, and New Mexico.

4. ORGANIZATIONAL CHART

Figure 13 provides the organizational chart for this project. This organizational approach has been developed based on best practices derived from TxDOT's and the three partnering state DOT's history of successfully delivering hundreds of millions of dollars of ITS and operations projects in the Southwestern United States. Unique features of this approach include continuous stakeholder involvement and use of a project delivery approach where a systems engineering contractor that is already under contract with TxDOT will provide key technology design, implementation, and deployment advice to the TxDOT Program Manager and the four state DOT lead staff during project execution. Note that biographical information of the staff shown in this chart is presented in Section IV, with résumés and bios provided in Appendix A.

Figure 13: Organizational Chart



The specific organizational roles provided on the organizational chart are detailed here:

- **Program Manager (Key Staff).** The Program Manager will deliver all necessary reports and information required by U.S. DOT to successfully administer this grant – providing streamlined, "one-stop-shopping" to U.S. DOT ATCMTD program staff. The Program Manager will assure the commitment of the proposed team and support staff and will be responsible for implementing quality control procedures that will encompass TxDOT and contractor activities over the course of the project. The Program Manager will also manage the necessary contractor procurement activities, including the selection of a System Integration Team early in year two of the project.
- **State Project Leads (Four Key Staff) and ITS/Operations Staff.** Each state DOT (CA, AZ, NM, and TX) has a "State Project Lead" that will be responsible for managing and coordinating

all necessary planning and deployment activities within their states, rest stop access, coordination with state enforcement agencies, and operations staff activities related to the information technology systems connectivity that will be necessary in deploying the TPAS. They will also be responsible for coordination with their respective state trucking associations to facilitate trucking industry participation. Each State Project Lead will be supported by a senior staff member from the DOT's ITS or Operations department – these individuals will provide engineering- and operations-level guidance and advice in support of each state's ATCMTD deployment activities. Resumes for the state leads and bios for the ITS/Operations Staff are included in Appendix A.

- **Public-Private Stakeholder Advisory Groups.** The ***User Advisory Group*** is the motor carrier operational stakeholder group, made up of truck drivers and trucking company dispatchers who utilize the I-10 Corridor on a regular basis. This group will be accessed early on to validate requirements for the technology applications and will be leveraged later in the project to participate in providing feedback on initial operations of the I-10 Corridor Coalition TPAS (e.g. beta testing). In addition, an ***Industry Working Group***, consisting of one leadership member from each of the four state trucking associations, will support this project by providing key reviews of appropriate project deliverables, and will assist the team by recruiting motor carrier participants for the User Advisory Group.
- **Systems Engineering Team.** Cambridge Systematics is already under contract on a TxDOT task that is working with the I-10 Corridor Coalition to define the I-10 Corridor Coalition TPAS. Upon ATCMTD grant award, this contract will be leveraged by TxDOT to have Cambridge Systematics perform systems engineering, preliminary design activities, and deployment coordination of the I-10 Corridor Coalition TPAS. As a result, this team will be immediately able to work on the ATCMTD project activities, substantially reducing project and schedule risk for this deployment project. Cambridge Systematics will also assist TxDOT in developing an RFP for the System Integration Team contractor, as detailed below. Bios for the Systems Engineering Team are included in Appendix A.
- **System Integration Team Procurement.** Assuming an October 2018 award, the broader technology system implementation and vendor procurement activity will begin exactly one year later in October 2019, and will take no longer than three months to complete. This will result in the selection of a System Integration Team contractor who will finalize and deploy the integrated system of I-10 Corridor Coalition TPAS project technologies with completions of all deployments and integration activities by Quarter 4 of FY 2021, as outlined in the Project Schedule. The System Integration Team will include all necessary subcontractors and vendors to deploy all the TPAS technologies across the four states.

5. MULTIJURISDICTIONAL GROUP

This project will represent the first cooperative deployment of technology undertaken by the I-10 Corridor Coalition. The I-10 Corridor Coalition is a cooperative partnership in the Southwestern United States that covers membership from four state DOTs: California, Arizona, New Mexico, and Texas. The four state DOTs are united by the pursuit of freight technology enhancements on the I-10 Corridor in their respective states.

The three completed and signed agreements from this group that will facilitate this successful ATCMTD deployment (a Joint Project Agreement, a Charter and an Operating Agreement), are covered in Section 1 above.

SECTION IV—STAFFING DESCRIPTION

1. STAFFING

The following summarize the lead persons for the project and technical support staff (see Table 11, below). Résumés and bios are included in Appendix A

Program Manager

George J. Villarreal, P.E., TxDOT, will be the overall Program Manager for this project. At TxDOT he is responsible for overseeing the four sections within the traffic operations division: traffic management, traffic engineering, traffic safety, and crash data analysis. Through his supervision of the four sections he ensures the Traffic Operations Division (TRF) supports the 25 TxDOT districts in the managing and implementation of guidelines associated with design, placement, and use of traffic control devices. He also assists the division in supporting the districts in the deployment and research of advanced computer applications, electronics, and communication technologies. This includes traffic signal hardware systems and application of intelligent transportation systems.

State Project Leads

Texas Lead: Caroline A. Mays, AICP, TxDOT

Caroline Mays is responsible for overseeing TxDOT's comprehensive and multimodal Freight, International Trade and Border Planning Programs. Her specific responsibilities include: 1) implementation of FAST Act freight provisions; 2) developing and implementing a comprehensive Statewide Freight Mobility Plan and Texas-Mexico Border Transportation Master Plan; 3) convening and managing the statewide Freight Advisory Committee and the Border Trade Advisory Committee; 4) developing statewide freight policies and investment strategies; 5) developing and carrying out strategic plan for TxDOT's activities for addressing freight, international trade and border issues; and 6) communicating and coordinating with internal and external stakeholders. Her experience in transportation planning includes: Freight Transportation, International Trade and Border; Intelligent Transportation Systems (ITS); Systems Management and Operations and Incident Management; Transit Planning; and Long Range Transportation Planning. She has presented on freight, International trade, border, and ITS transportation issues at national, state, regional, local, and industry forums and provides on-going technical assistance on the subject.

Arizona Lead: Reza Karimvand, P. E., ADOT

Mr. Reza Karimvand joined ADOT in 1995, following a 10-year private-sector career in transportation engineering. He has served ADOT in multiple capacities, including leading a number of key projects, such as: redesign of the ADOT Traffic Operations Center, the detour plan for full freeway closure in the Phoenix region; the statewide DMS Master Plan, signal centralization in the Greater Phoenix region, and a sophisticated technology for dust monitoring system on I-10.Nationally, Mr. Karimvand is active member of Strategic Initiatives Working Group (formerly known as V2I Deployment Committee) for Cooperative Automated Transportation (CAT) Coalition. He currently is now leading Arizona's participation in the I-10 Corridor Coalition, and is overseeing the development of an I-10 Corridor Connected Freight Concept of Operations. He also is a member of Signal Phasing and Timing (SPaT) challenge and U.S. DOT Multi-Modal Intelligent Traffic Signal System (MMITSS) Group which is responsible for formulation of guidance to public agencies throughout the nation. Mr. Karimvand graduated from the Louisiana Tech University and is a Registered Professional Engineer in the State of Arizona.

New Mexico Lead: Paul A. Sittig, NMDOT

Paul Sittig, New Mexico DOT's lead freight planner, has been with NMDOT since November 2012, where he has overseen the development of the state's freight plan under MAP-21, and an update to the New Mexico Freight Plan under the FAST Act. In addition to freight planning, he manages the roadway classifications for the state, including the Functional System and National Highway System, and supervises technical and freight planning staff.

California Lead: Joe Rouse, Chief of the Office of System Operations for the Division of Traffic Operations at the California Department of Transportation (Caltrans). The Office of System Operations provides leadership in mobility management on the California State Highway System through operational strategies, incident management and traveler information. The office oversees managed lanes operations, traveler information programs, and the state's 12 Transportation Management Centers, which track and manage road conditions on the State Highway System. Joe is also the department's technical and policy expert on tolling and congestion pricing.

Table 11. Highlights of Technical Team Staff Qualifications

Staff Name	Org Chart Category(s)	Qualifications Summary
Charla A. Glendening, AICP	ADOT ITS/ Operations	• Statewide Planning Manager • Oversees Long Range Transportation Plan, Freight Plan, Bike/Ped Plan and the Tribal Program
Charles Remkes	NMDOT ITS/ Operations	• NMDOT's Chief of Intelligent Transportation Systems • ITS planning, design, construction, deployment, operations and maintenance as well as administering all ITS-related budgets and financial tracking
George J. Villarreal, P.E.	TxDOT ITS/ Operations	• Overall Program Manager for I-10 CC TPAS and state technical staff lead in traffic management, traffic engineering, traffic safety, and crash data analysis for TxDOT
Joe Rouse	Caltrans ITS/ Operations	• Caltrans state lead for I-10 CC TPAS and technical staff lead in systems operations/traffic operations
Mark Jensen	Systems Engineering Team	• 30 years advanced technology systems engineering experience • ConOps, Requirements, Design, Deployment of U.S. DOT CV applications
Daniel Stock	Systems Engineering Team	• 37 years of experience in quantitative/economic analysis • 24 years of experience in ITS deployment, testing and evaluation
Krista L. Jeannotte	Systems Engineering Team	• 25 years of experience specializing in ITS and freight technology applications, systems engineering, and the evaluation of technology deployments
Brian Stewart	Systems Engineering Team	• Specializes in freight and intermodal planning, logistics operations, and commercial vehicle operations

2. PRIMARY POINT-OF-CONTACT

George J. Villarreal, P.E.

Deputy Director Traffic Operations Division at Texas Department of Transportation

14555 Blanco Rd. San Antonio, TX 78216

Cell: 806-577-2305 | Email: gjuan.v@gmail.com

APPENDIX A: RÉSUMÉS

PART 1: KEY STAFF RÉSUMÉS

Program Manager

George J. Villarreal, P.E.
14555 Blanco Rd. San Antonio, TX 78216
Cell: 806-577-2305 | Email: gjuan.v@gmail.com

YEARS OF EXPERIENCE: 15

- Deputy Director Traffic Operations Division
- Texas Department of Transportation

BIOGRAPHICAL SUMMARY

George Villarreal is responsible for overseeing the four sections within the traffic operations division: traffic management, traffic engineering, traffic safety, and crash data analysis. Through his supervision of the four sections he ensures the Traffic Operations Division (TRF) supports the 25 TxDOT districts in the managing and implementation of guidelines associated with design, placement, and use of traffic control devices. He also assists the division in supporting the districts in the deployment and research of advanced computer applications, electronics, and communication technologies. This includes traffic signal hardware systems and application of intelligent transportation systems.

HIGHLIGHTS OF TRANSPORTATION ENGINEERING EXPERIENCE

Texas Department of Transportation (TxDOT)—Serves as a representative for TxDOT on an AASHTO Innovation Initiative that works collectively with representatives from the states of Rhode Island, Arizona, and North Carolina as lead states to develop a guidance document on the implementation of a wrong way driving program.

Texas Department of Transportation (Lubbock District)—Planned, designed, and oversaw construction of TxDOT Lubbock District first ITS system. The system included dynamic message signs, closed circuit cameras, and microwave vehicle detection system.

Kimley Horn & Assoc—Developed curriculum and instructed courses based on the PMP Transportation Learning Path certification which included courses in: Risk Based Construction Cost Estimating, Transportation Engineering Project Management, Transportation Engineering P6 Scheduling, and Risk Management.

Texas Tech Whitacre College of Engineering—Served as an adjunct professor for a senior level undergraduate transportation engineering course. Developed curriculum and instructed a dedicated transportation engineering course that covered roadway, railroad, safety, and aviation engineering. I also served as a faculty advisor for the student chapter of the Institute of Transportation Engineers and advisor for transportation engineering graduate student research programs.

EDUCATION

Bachelors of Science, Civil Engineering University of Texas at San Antonio, May 2003

PROFESSIONAL LICENSURE

Licensed Professional Engineer, State of Texas, No. 102457

Licensed Professional Engineer, State of New Mexico, No. 20098

PAST WORK EXPERIENCE

Dates	Position(s)	Organization
Oct 2017—Present	Deputy Director Traffic Operations Division	Texas Department of Transportation
Jan 2016—Sep 2017	Project Manager	Kimley Horn & Assoc
Aug 2014—Dec 2015	Adjunct Professor	Texas Tech Whitacre College of Engineering
May 2003—Dec 2015	Lubbock District Traffic Engineer	Texas Department of Transportation

State Project Leads

Caroline A. Mays, AICP – Texas Lead Director
1300 Red River Dr., Aubrey, TX 76227
Cell: 770-519-0349 | Email: carolineaam@yahoo.com

YEARS OF EXPERIENCE: 19

- Director, Freight and International Trade Section
- Texas Department of Transportation

BIOGRAPHICAL SUMMARY

Caroline Mays is responsible for overseeing] TxDOT's comprehensive and multimodal Freight, International Trade and Border Planning Programs. Her specific responsibilities include: 1) implementation of FAST Act freight provisions; 2) developing and implementing a comprehensive Statewide Freight Mobility Plan and Texas-Mexico Border Transportation Master Plan; 3) convening and managing the statewide Freight Advisory Committee and the Border Trade Advisory Committee; 4) developing statewide freight policies and investment strategies; 5) developing and carrying out strategic plan for TxDOT's activities for addressing freight, international trade and border issues; and 6) communicating and coordinating with internal and external stakeholders. Her experience in transportation planning includes: Freight Transportation, International Trade and Border; Intelligent Transportation Systems (ITS); Systems Management and Operations and Incident Management; Transit Planning; and Long Range Transportation Planning. She has presented on freight, International trade, border, and ITS transportation issues at national, state, regional, local, and industry forums and provides on-going technical assistance on the subject.

HIGHLIGHTS OF TRANSPORTATION PLANNING EXPERIENCE

Texas Department of Transportation (TxDOT)—Director, responsible for spearheading the development of the Agency's Freight Planning Program and creating and overseeing the Texas Freight Advisory Committee and as well as spearheading the development of the Texas Freight Mobility Plan.

Texas Freight Mobility Plan—Program director responsible for overseeing the development and implementation of this statewide comprehensive and multimodal freight mobility plan.

Texas-Mexico Border Transportation Master Plan—Program director responsible for overseeing the development of the binational comprehensive and multimodal border transportation master plan and overseeing the Border Trade Advisory Committee.

Atlanta Regional Freight Planning Program—Program manager responsible for initiating and developing the Atlanta Regional Commission's freight planning program. Created an on-ongoing Freight Advisory Task Force comprised of freight stakeholders and other regional planning partners to discuss and address freight and goods transportation issues in the Atlanta region.

Atlanta Regional Freight Mobility Plan (Winner of 2008 AMPO Award)—Project manager responsible for overseeing the development of the Atlanta region's first comprehensive freight mobility plan that addresses freight and goods movement challenges and opportunities.

Atlanta Regional Intelligent Transportation Systems (ITS) Architecture and Strategic Plan—Project manager responsible for spearheading the development of the Atlanta Regional ITS Architecture and Strategic Plan. Managed the implementation and maintenance of Architecture and Strategic Plan. Also oversaw the Architecture compliance including utilization of Systems Engineering Approach in all ITS projects deployed in the region and ensured the architecture was used to support ITS project implementation.

EDUCATION

M.Sc. Pl., Urban and Regional Planning, University of Toronto, 1998

BES, Honors Urban and Regional Planning, University of Waterloo, 1996

AFFILIATIONS AND REGISTRATIONS

- A member of the American Planning Association (APA) and member of the American Institute of Certified Planners (AICP)
- Chair of the Transportation Research Board (TRB) Agricultural Transportation Committee and a member of the Intermodal Freight Transportation Committee and a friend of the Urban Freight Committee, and Freight and Logistics Planning Committee.

PAST WORK EXPERIENCE

Dates	Position(s)	Organization
Feb 2016—Present	Director, Freight and International Trade Section	Texas Department of Transportation
Jul 2013—Jan 2016	Freight Transportation Planning Branch Manager	Texas Department of Transportation
Nov 2012—Jun 2013	Statewide Freight Planning Coordinator	Texas Department of Transportation
Dec 2001—Jan 2009	Principal Transportation Planner	Atlanta Regional Commission (ARC) Transportation Planning Division
Feb 1999—Nov 2001	Transportation Planner-Transit	County of Rockland Department of Planning and Public Transportation
Jun—Aug 1997	Intern	United Nations

Reza Karimvand, PE

Arizona Department of Transportation – Arizona Lead

OVERVIEW

A transportation professional offering 30 years of experience in planning, design, and construction of the roadway; traffic engineering elements and intelligent transportation systems. Thorough understanding of federal, state, and local policies in administering transportation services and managing projects, with the proven ability to integrate technical, institutional, and financial elements for sustainable development. Demonstrated ability to proactively lead and motivate diverse team of professionals to new level of success (Transportation Technology Group at the TOC August 2010-December 2015, prior to formation of TSMO). Proven ability to successfully analyze and identify potential challenges and opportunities, and develop innovative solutions to promote efficiency and improve customer experience. Ability to apply for and successfully receive funding for Federal Grants (TIGER Grant, Advanced Congestion Managements Grant, FASTLANE Grant, SHRP 2 L02/L07 Grant and Commercial Vehicle Information Systems and Networks (CVISN) Grant.

EDUCATION

Bachelor of Science in Civil Engineering
Louisiana Tech University, Ruston, Louisiana, March 1982

PROFESSIONAL REGISTRATION

- Registered Professional Engineer (Civil), State of Arizona, Registration # 35893

PROFESSIONAL AFFILIATIONS

- Institute of Transportation Engineers (ITE)—Member Status
- American Society of Civil Engineers (ASCE)—Member Status
- Intelligent Transportation System (ITS) Arizona Chapter—Member Status
- National Academies Transportation Research Board, NCHRP Project Panel Member
- AASHTO Subcommittee on Vehicle to Infrastructure (V2I) Deployment Initiative Technical Group
- Member of National Committee on Multi-Modal Intelligent Traffic Safety System (MMITSS) Development Group (MDG)

EXPERIENCE

10/2015 (formation of TSMO Division) to Present—Arizona Department of Transportation, Phoenix, Arizona.

Systems Technology and Innovation Development Manager

- Overseeing the development of ITS Technology statewide including:
  - » Connected Vehicle (CV) program
  - » Integrated Corridor Management (ICM)
  - » Smart Truck Parking (STP)
  - » Performance Measure (PM)
  - » Smart Ramp Metering (SRM)
  - » Dust Warning System (DWS)
  - » Signal Centralization System (SCS)
- Led multiple successful Federal Grant applications to the funding stage: Loop 101 Mobility ($6 mil), Fast Lane ($50 mil), CVSIN (300k), and SHRP 2 L02/L07 Performance Measure ($100k).
- Leading the effort and instrumental in the success of the I-10 Corridor Coalition which will allow the efficient flow of Trucks from Texas to California through collective resource sharing and automation to provide seamless travel for the Trucking Community.
- Coordinated interactions with the American Indian Tribes and Communities in Arizona regarding I-10 Corridor Coalition. Specifically the Gila River Indian Community, Ak-Chin Indian Community, Tohono O'odham Nation and Salt River Pima-Maricopa Indian Community.
- Leading and overseeing the Design and Construction of highly sophisticated dust monitoring system on I-10 in Pinal County area, including Variable Speed Limit (VSL), Fiber Optics

Backbone, Dynamic Message Signs (DMS), X-Band radar system and integration of entire system into State Traffic Operation Center.

- Leading Workforce Development project for ITS and TSMO in regional level. After completion of this project, this report will be integrated to U.S. DOT's national effort for ITS workforce development in the nation.
- On a National Level:
  - A member of Vehicle to Infrastructure (V2I) Deployment Initiative Technical Group, which offers review and input to the U.S. DOT connected vehicle guidance and related program and products.
  - A member of Signal Phasing and Timing (SPaT) challenge and U.S. DOT Multi-Modal Intelligent Traffic Signal System (MMITS) Group which is responsible for formulation of guidance to public agencies throughout the nation.
  - Champion for ITS workforce development and presenter in U.S. DOT National Webinar in ITS workforce development.
- Contributing member of several National Cooperative Highway Research Program (NCHRP), specifically NCHRP 03-124, "*Principle and guidance for presenting Drivers with Dynamic Information on Active Traffic Management*" and NCHRP 20-68A, "*US Domestic Scan Program, Integrated Corridor Management (ICM)"*.
- Successfully led the incident driven ICM program for Loop 101 in Scottsdale that has received National attention for being low-cost and a highly successful program for incident-driven congestion management among ADOT, MCDOT and City of Scottsdale.
- Leading the Systems Technology Development through multimillion dollar projects statewide.

09/2010 to 10/2015—Arizona Department of Transportation, Phoenix, Arizona

Assistant State Engineer

- Led all Intelligent Transportation Systems (ITS) for the ADOT. Duties included providing oversight and guidance to Planning, Development, Design, Construction support, System Integration as well as Operation and Maintenance of all ITS system and Active Traffic Management Systems statewide.
- Led the Project Management for:
  - Active Traffic Management Systems (ATMS)
  - Traveler Information Systems (TIS)
  - Traffic Incident Management (TIM)
  - Rural Transportation Systems (RTS)
  - Traffic Signal Synchronization (TSS)
  - Multi-Modal Intelligent Traffic Signal System (MMITSS)
- Led the redesign of state of the art Traffic Operations Center, a multi-million dollar project, to bring Active Traffic Management (ATM), Traffic Incident Management (TIM) and Travel Time Expansion (TTE) to the forefront, making Arizona a National Leader in ITS.
- Managed the Traffic Operation Center. A 24-hour operation that managed traffic-impacting incidents on the state highway system.
- Responsible for $2.5M annual budget for administration and maintenance.
- Led Active Traffic Management including Variable Speed Limit (VSL), Wrong Way Detection (WWD), Smart Ramp Metering (SRM) in the Maricopa Association of

Governments (MAG) region, as well as Integrated Corridor Management (ICM) for Loop 101 in the Phoenix area.

- Leading member of Arizona Connected Vehicle Program.
- Actively involved as a subject matter expert for incorporating ATM technology, on the 22 mile Loop 202, Multi Billion dollars expansion project.
- Instrumental in highly intense and time restricted review of Federal Grant reports (FAST LANE, ATCMTD for Loop 101 Mobility project).

10/2001 to 08/2010—Arizona Department of Transportation, Tucson, Arizona
Regional Traffic Engineer, Southern Region

09/1997 to 09/2001—Arizona Department of Transportation, Tucson, Arizona
Transportation Engineering Specialist, Southern Region

04/1995 to 09/1997—Arizona Department of Transportation, Phoenix, Arizona
Transportation Engineering Specialist, Traffic Engineering Design Group

1/1992 to 04/1995—Engineers International, Inc., Tucson, Arizona
Civil Engineer

1/1991 to 12/1992—MOD Construction Company, Rockville, Maryland
Construction Division Manager

Paul A. Sittig—New Mexico Department of Transportation

New Mexico Lead

EXPERIENCE SUMMARY

Over 10 years of planning, program and staff management experience, more than five of which are from my work at the New Mexico Department of Transportation, where I started as a Urban and Regional Planner-Advanced in November 2012, where I was NMDOT's state freight planner. I was promoted to Technical & Freight Planning Supervisor in July 2017. My project management responsibilities include technical review of the major statewide functional classification re-evaluation, and managing the Freight-Related Economic Development Opportunity Study. My staff managerial responsibilities have also included personnel oversight and development.

EDUCATION

B.S., City and Regional Planning, Cal Poly San Luis Obispo, 2008

EMPLOYMENT HISTORY

Planner I with the County of San Luis Obispo, 2007—2012

New Mexico Department of Transportation, 2012—present

EXPERIENCE

New Mexico Department of Transportation, 2012—present
Technical & Freight Planning Supervisor

I currently manage statewide, multimodal freight planning for the NMDOT, coordinating with Rail and Aviation Bureaus who also include freight planning for their respective modes, as well the Metropolitan Planning Organizations (MPO) and NMDOT's US/Mexico border-focused International Programs in their regional freight planning efforts. Additionally, I coordinate with the I-10 Connected Freight Corridor Coalition and the Western States Freight Coalition, both regional planning efforts focused on freight, and represent New Mexico in national freight-related transportation issues and coordination. I also worked developed a freight project selection and prioritization matrix, and with consultant support, updated the New Mexico Freight Plan to be FAST Act compliant.

I manage the roadway classifications for NMDOT, including National Highway System and Functional System classifications, working with MPOs, Regional Transportation Planning Organizations (RTPO) and NMDOT Districts to ensure that local roadway use is reflected to support project development and prioritization, as well as funding eligibility and reporting requirements. I also manage staff who work on technical and freight planning efforts.

I oversee the management of the New Mexico Statewide Travel Demand Model (NMSTDM), including dedicated staff and contracts to support the maintenance and upgrade of the NMSTDM, to ensure this tool is kept current and useful for future forecasts and project evaluations.

I also manage the Local Technical Assistance Program (LTAP), both the heavy equipment trainer with NMDOT and the contract with the University of New Mexico (UNM) to serve as the New Mexico LTAP Center.

Urban and Regional Planner – Advanced

While working as an Urban and Regional Planner, I started serving as the freight planner for NMDOT, coordinating with partners in the state and beyond, and oversaw the development of the MAP-21 compliant State Freight Plan.

I served as the technical manager of the statewide Functional System re-evaluation, working with consultants to capture and accurately reflect roadway use conditions throughout the state in coordination with local entities.

I also managed the Northeast RTPO, overseeing the work of two individuals who worked to develop and implement the regional transportation plan.

County of San Luis Obispo

Planner I, 2007 – 2012

While working at the County of San Luis Obispo, I processed land use, grading, cellular facility and subdivision permits, ensuring compliance with local and state regulations, presenting projects to local community groups for public input, and to hearing boards for final decisions.

Joseph Rouse—CALTRANS—California Lead

5716 Nonnie Avenue Sacramento, CA, 95841 | (916) 969-9824 | josefmrouse@gmail.com

SUMMARY

Joe Rouse serves as the chief of the Office of System Operations for the Division of Traffic Operations at the California Department of Transportation (Caltrans). The Office of System Operations provides leadership in mobility management on the California State Highway System through operational strategies, incident management and traveler information. The office oversees managed lanes operations, traveler information programs, and the state's 12 Transportation Management Centers, which track and manage road conditions on the State Highway System. Joe is also the department's technical and policy expert on tolling and congestion pricing.

PROFESSIONAL EXPERIENCE

Caltrans Division of Traffic Operations—Sacramento, CA

Supervising Transportation Engineer October 2017—Present

Serving as chief of the Office of System Operations in the Division of Traffic Operations, directing and supervising staff in the statewide program oversight of managed lanes operations, park & ride facilities, traveler information programs, incident management, and lane closure management.

Supervising Transportation Engineer October 2015—October 2017

Served as the Program and District Liaison for the Division of Traffic Operations at Caltrans HQ. Acted as a coordinator between Traffic Operations and other Divisions in Caltrans and the Federal Highway Administration to help address engineering and business issues. Provided technical support and assistance to Caltrans District staff, regional transportation agencies, and consultants on managed lanes projects.

Supervising Transportation Engineer August 2013—August 2015

Responsible for strategic planning and policy development for managed lanes on the California state highway system (either HOV lane improvements or new HOV/HOT/express toll lane projects). Provided technical support to Caltrans and regional transportation agency partners on the development and operation of managed lanes. Worked on the feasibility of Caltrans developing priced managed lanes systems and expanding the department's tolling authority.

Senior Transportation Engineer November 2007—August 2013

Functional manager for the managed lanes and park & ride programs. Developed statewide policies and procedures for programs and helped develop program budgets and workload standards. Worked with local agencies and Caltrans Districts on managed lane planning efforts and provided technical support on the development and operation of managed lanes.

Caltrans District 3 Division of Traffic Operations—Sacramento, CA

Senior Transportation Engineer August 2015—October 2015

Served as Acting Chief of the Office of Freeway Operations. Directed and supervised engineers and administrative personnel in activities such as safety and operation reviews, freeway operations, ramp metering operations and studies, environmental document reviews, managed lane operations and studies, and production and review of traffic reports.

Transportation Engineer April 2005—April 2007

Project engineer for minor safety and operational improvement projects. Developed signing and striping plans for various jobs in District.

Transportation Engineer November 2001—August 2004

Collected and reviewed traffic count data to analyze and develop work windows for planned traffic restrictions. Advised field staff on appropriate work windows. Assisted in the development of traffic management plans for small and large scale closures. Evaluated closures to determine real-time traffic conditions.

Caltrans North Region Construction—Marysville, CA

Transportation Engineer May 2007—November 2007

Served as resident engineer on "Safe Routes to School" project, which included installation of first traffic signal in the community. Developed numerous design changes to address errors and differing site conditions. Delivered project on time and within budget.

Caltrans North Region Division of Design & Engineering Services—Sacramento, CA

Transportation Engineer March 1999—October 2001

Developed project studies and supporting documents and performed design work on various roadway projects, including freeway reconstruction, highway widening, roadway rehabilitation, and traffic signals. Participated in rotational assignment in North Region Division of Construction. Served as construction inspector on roadway rehabilitation projects and a freeway widening and interchange reconstruction project. Participated in rotational assignment in District 3 Division of Traffic Operations. Studied the impacts of various traffic operational improvements, participated in congestion monitoring, and conducted traffic counts.

EDUCATION

California State University, Sacramento—Sacramento, CA

BS, Civil Engineering, Dec 1998

San Jose State University—San Jose, CA

MS, Transportation Management, Jun 2008

Capstone paper was "Improving the Implementation of Tolled Road Facilities in California". Paper was nominated by the University as a candidate for an award from the Council of University Transportation Centers.

RESUME APPENDIX – PART 2: BIOGRAPHIES FOR SELECTED TECHNICAL TEAM STAFF

State Technical Staff

Texas ITS/Operations Staff: **George J. Villarreal** of TxDOT is also the Texas IT technical lead person.

Arizona ITS/Operations Staff: **Charla A. Glendening**, AICP, ADOT. Ms. Glendening is the Statewide Planning Manager for the Arizona Department of Transportation (ADOT) in Phoenix. She supervises statewide plans including the Long Range Transportation Plan, Freight Plan, Bike/Ped Plan and the Tribal Program. She has worked in the field of Planning for 19 years, and her experience includes both public and private sector work. Charla received her Bachelor's degree in Urban Planning from the University of Colorado, Boulder and is a certified professional planner through the American Planning Association.

New Mexico ITS/Operations Staff: **Charles Remkes**, NMDOT. Mr. Remkes, NMDOT's Chief of Intelligent Transportation Systems (ITS) manages the NMDOT's Intelligent Transportation Systems. This entails all of the NMDOT's activities associated with ITS planning, design, construction, deployment, operations and maintenance as well as administering all ITS-related budgets and financial tracking. He gives strategic direction for the planning and implementation of advanced technology applications at both the Transportation Management Center in Albuquerque and for ITS services throughout the state. It includes applications related to traffic operations, traveler information dissemination, incident detection/management, road weather management, and construction activities. He oversees the development of the technical specifications, standard serial drawings and classifications used for ITS equipment on NMDOT projects and have the continued responsibility for their maintenance including any associated revisions. He ensures the NMDOT's operations continue to be in full compliance with all federal and state regulations including ITS Architecture maintenance and ITS Systems Engineering requirements for project development.

California ITS/Operations Staff: **Joe Rouse**, Chief of the Office of System Operations for the Division of Traffic Operations at the California Department of Transportation (Caltrans) will also be acting as the California technical contact, until staff is assigned to the role.

SYSTEMS ENGINEERING TEAM

Cambridge Systematics is already under contract on a TxDOT task that is working with the I-10 Corridor Coalition to define the I-10 Corridor Coalition TPAS. Upon ATCMTD grant award, this contract will be leveraged by TxDOT to have Cambridge Systematics perform systems engineering, preliminary design activities, and deployment coordination of the I-10 Corridor Coalition TPAS. The Cambridge Systematics team will consist of Mark Jensen, Krista Jeannotte, Daniel Stock and Brian Stewart. Their bios are below.

Mark Jensen is a Principal and Senior Systems Engineer with Cambridge Systematics, has 30 years of experience, and is a specialist in the development of freight technology applications. He recently completed supporting Caltrans and FHWA on a groundbreaking V2V prototype test program which successfully demonstrated truck platooning using Volvo trucks on California Freeways. Between 2011 and 2015, in support of LA METRO and FHWA, and involving the Gateway Cities COG, the two ports, and trucking/terminal industry stakeholders, he led the development of the Freight Advanced Traveler Information System (FRATIS) ConOps, System

Requirements, architecture, development and testing in Los Angeles. Additionally, he is currently working with Caltrans, Arizona DOT, NMDOT and TxDOT to develop a ConOps for the I-10 Connected Corridor between California and Texas.

Krista L. Jeannotte is a Principal of Cambridge Systematics, has more than 25 years of experience, and is a specialist in ITS and freight technology applications, systems engineering, and the evaluation of technology deployments. Some example projects include: Alameda County Transportation Commission (ACTC) 7th Street Grade Separation and Port Arterial Improvements Project – Port of Oakland Freight ITS; Gateway Cities ITS Implementation Plan for Goods Movement; FHWA Developing and Testing FRATIS with Public and Private Partners in the Los Angeles-Gateway Region; and Tranzit Xpress Hazmat Fleet Management and Monitoring System Evaluation. Ms. Jeannotte received a Master's degree in Civil Engineering, Transportation from the University of California at Berkeley; and a Bachelor's degree in Civil Engineering from the California State Polytechnic University at Pomona.

Daniel Stock, who recently joined Cambridge Systematics (CS), has 37 years of experience including economic assessment, benefit/cost analysis, operations analysis, policy analysis, business case development, and research design and management. His focus for the past 24 years has been on determining impacts of programmatic, technological and infrastructure improvements on the profitability, safety and security of transportation investments. Mr. Stock has also led a number of technology pilot tests and deployments including Commercial Vehicle safety and security technology systems and governmental ITS systems, many of which were turnkey systems still in operation by private and local and state agency stakeholders.

Brian Stewart. Mr. Stewart is an Associate with Cambridge Systematics with a deep background in planning for commercial vehicles operation, safety, and parking and FMCSA-related technology deployments. Relevant experience includes: Serving as DPM on the Nevada Truck Parking Implementation Plan; Serving as technical lead or DPM on a number of weigh station (for Washington State JTC, Idaho Transportation Department, Tennessee Highway Patrol, and Arizona DOT) and truck routing (Chicago Metropolitan Agency for Planning and Harris County, TX) projects; and Involvement with FMCSA projects examining the efficiency of electronic screening technology and potential programs for FMCSA's "Beyond Compliance" efforts in addition to supporting the ITD program both directly to FMCSA and as part of a Program Management team for the State of Tennessee.

APPENDIX B: LETTERS OF SUPPORT

June 8, 2018

Ms. Brandye L. Hendrickson
Acting Administrator
Federal Highway Administration
U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC 20590

RE: TxDOT Grant Application for ATCMTD program
I-10 Western Connected Freight Corridor Truck Parking Availability System (TPAS)

Dear Administrator Hendrickson:

Please accept this letter of support for the Texas Department of Transportation's (TxDOT) application to the Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) program to fund the I-10 Western Connected Freight Corridor Truck Parking Availability System (TPAS). Applying technology to improve the safety and mobility of freight along I-10 is an important foundation for economic development and efficiency in Texas and the southwestern United States.

This proposed project will cover four states along the I-10 corridor (Texas, New Mexico, Arizona, and California) and be led by Texas, the state with the most mileage along I-10. The TPAS project will help mitigate safety issues related to locating truck parking by providing drivers and their dispatcher's real-time information on where empty parking spots are in public rest areas along I-10 from Texas to California. This advanced technology project will thus contribute to the adopted state and federal goals of improved safety, efficiency, system performance, and infrastructure return on investment.

Thank you for your consideration of TxDOT's application and for your continued service to our nation. Should you have any questions, please do not hesitate to contact me.

Sincerely,

Isidro (Sid) Martinez
Director

825 South Saint Mary's Street • San Antonio, Texas 78205
(210) 227-8651 (210) 227-9321 TTD 1 (800) 735-2989
www.alamoareampo.org

El Paso Metropolitan Planning Organization

June 18, 2018

Ms. Brandye L. Hendrickson
Acting Administrator
Federal Highway Administration
U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC 20590

RE: TxDOT Grant Application for Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) program
I-10 Western Connected Freight Corridor Truck Parking Availability System (TPAS)

Dear Administrator Hendrickson:

The El Paso Metropolitan Planning Organization supports the Texas Department of Transportation's (TxDOT) application to the Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) program to fund the I-10 Western Connected Freight Corridor Truck Parking Availability System (TPAS). Applying technology to improve the safety and mobility of freight along I- 10 is an important foundation for economic development and efficiency in Texas and the southwestern United States.

This proposed project will cover four states along the I-10 corridor (Texas, New Mexico, Arizona, and California) and be led by Texas, the state with the most mileage along I-10. The TPAS project will help mitigate safety issues related to locating truck parking by providing drivers and their dispatcher's real-time information on where empty parking spots are in public rest areas along I-10 from Texas to California. This advanced technology project will thus contribute to improved safety, efficiency, system performance, and infrastructure return on investment.

Thank you for your consideration of TxDOT's application. Should you have any questions, please feel free to contact me at (915) 212-0258.

Sincerely,

Michael Medina, CNU-A
Executive Director

211 N. Florence Street, Suite 202 El Paso, Texas 79901 Phone: (915) 212-0258 Fax (915) 212-0257
www.elpasompo.org

NEW MEXICO TRUCKING ASSOCIATION, INC.
4700 LINCOLN NE • ALBUQUERQUE, NEW MEXICO 87109
(505) 884-5575 • FAX (505) 342-6308 www.nmtrucking.org

Secretary Elaine L. Chao
US Department of Transportation
1200 New Jersey Ave, SE
Washington, DC 20590

Dear Secretary Chao:

We are aware that the states of Texas, New Mexico, Arizona and California (the ***I-10 Corridor Coalition***) are responding, with the Texas Department of Transportation as the lead agency, to a Notice of Funding Opportunity from the U.S. Department of Transportation (USDOT) under the ATCMTD program for the final design and full implementation of the **I-10 Truck Parking Availability System (TPAS)**.

The New Mexico Trucking Association Inc and its 250+ members and our concern for Highway safety believe this project is essential to that goal.

We understand that this project would help improve highway safety, both for commercial drivers and the public. It would provide commercial drivers with reliable information about where they can safely park to rest, reduce hazardous ramp and shoulder parking, and help insure drivers on the road are well rested. This project will benefit private sector freight and shipping services by making commercial drivers and freight trucks more productive during their hours of service, thereby increasing economic competiveness along the I-10 corridor.

New Mexico Trucking Association supports the I-10 Corridor Coalition's bid to deploy the TPAS system for this project. Also, if the I-10 Corridor Coalition is successful in obtaining USDOT funding for this project, New Mexico Trucking Association would like to volunteer to assist the I-10 Corridor Coalition and USDOT by being an active stakeholder on the project, and in providing access to member motor carriers and trucking fleets for planning and fielding these technologies. We believe that our involvement is this project will be crucial in supporting the design and deployment of a system that meets the needs of our member drivers.

Sincerely,

Johnny R. Johnson
New Mexico Trucking Association Managing Director

ARIZONA TRUCKING association

June 5, 2018

Secretary Elaine L. Chao
US Department of Transportation
1200 New Jersey Ave, SE
Washington, DC 20590

Dear Secretary Chao:

We are aware that the states of Texas, New Mexico, Arizona and California (the ***I-10 Corridor Coalition***) are responding, with the Texas Department of Transportation as the lead agency, to a Notice of Funding Opportunity from the U.S. Department of Transportation (USDOT) under the ATCMTD program for the final design and full implementation of the **I-10 Truck Parking Availability System (TPAS)**.

The Arizona Trucking Association (ATA) is a non-profit trade association that promotes safety and represents the trucking interests in Arizona. We represent fleets of virtually every size and sector that operate in Arizona. ATA serves as the trucking industry's primary voice on transportation and other public policy issues. Additionally, we work hand and hand with our the public sector partners to promote safety on our nation's roads and highways.

We understand that this project would help improve highway safety, both for commercial drivers and the public. It would provide commercial drivers with reliable information about where they can safely park to rest, reduce hazardous ramp and shoulder parking, and help insure drivers on the road are well rested. And by making the commercial driver and the truck more productive during their hours of service, this project will result in improved benefits to private sector freight and shipping services, this enhancing economic competiveness along the I-10 corridor.

The Arizona Trucking Association supports the I-10 Corridor Coalition's bid to deploy the TPAS system for this project. Also, if the I-10 Corridor Coalition is successful in obtaining USDOT funding for this project, the Arizona Trucking Association would like to volunteer to assist the I-10 Corridor Coalition and USDOT in being an active stakeholder on the project, and in providing access to member motor carriers and trucking fleets to assist the I-10 Corridor Coalition in planning and fielding these technologies. We believe that our involvement is this project will be crucial in supporting the design and deployment of a system that meets the needs of our member drivers.

Sincerely,

Tony Bradley
President and CEO

June 5, 2018

Secretary Elaine L. Chao
US Department of Transportation
1200 New Jersey Ave, SE
Washington, DC 20590

Dear Secretary Chao:

We are aware that the states of Texas, New Mexico, Arizona and California (the ***I-10 Corridor Coalition***) are responding, with the Texas Department of Transportation as the lead agency, to a Notice of Funding Opportunity from the U.S. Department of Transportation (USDOT) under the ATCMTD program for the final design and full implementation of the **I-10 Truck Parking Availability System (TPAS)**.

The CTA is the nation's largest statewide trade association representing the trucking industry. Established in 1934, our 1,400+ members represent all segments of the industry, including both small and mid-sized family owned companies headquartered in California as well as large logistics providers in the Fortune 1000.

We understand that this project would help improve highway safety, both for commercial drivers and the public. It would provide commercial drivers with reliable information about where they can safely park to rest, reduce hazardous ramp and shoulder parking, and help insure drivers on the road are well rested. And by making the commercial driver and the truck more productive during their hours of service, this project will result in improved benefits to private sector freight and shipping services, this enhancing economic competiveness along the I-10 corridor.

The California Trucking Association supports the I-10 Corridor Coalition's bid to deploy the TPAS system for this project. Also, if the I-10 Corridor Coalition is successful in obtaining USDOT funding for this project, CTA would like to volunteer to assist the I-10 Corridor Coalition and USDOT in being an active stakeholder on the project, and in providing access to member motor carriers and trucking fleets to assist the I-10 Corridor Coalition in planning and fielding these technologies. We believe that our involvement is this project will be crucial in supporting the design and deployment of a system that meets the needs of our member drivers.

Sincerely,

Eric Sauer
CTA Senior Vice President of Government Affairs

APPENDIX C: BENEFIT/COST ANALYSIS

BENEFIT ANALYSIS

The envisioned I-10 Corridor Coalition TPAS project is anticipated to provide benefits in the areas of safety (crash reduction from searching for parking while fatigued and/or beyond their HOS and parking in unsafe conditions), mobility (reduced travel-time savings due to reduced crashes and truck driver time searching for parking), environmental (reduced truck emissions and fuel use), other cost savings (nonfuel vehicle operating costs from reduced miles searching for parking), and state of good repair (reduced wear and tear on roadway ramps and shoulders from illegal truck parking). The benefit/cost analysis was performed utilizing the FHWA Tool for Operations Benefit/Cost Analysis (TOPS-BC) and other spreadsheet methods. The benefits analysis was informed by additional inputs from:

- Emissions, vehicle delay, and fuel use associated with truck crashes and fatigue-related crashes from U.S. DOT Federal Motor Carrier Safety Administration (FMCSA).
- Accident data from Texas Peace Officer's Crash Reports processed by the TxDOT, University of New Mexico, Geospatial and Population Studies, Traffic Research Unit (TRU) on behalf of NMDOT, ADOT Statewide Safety Data Mart Crash Data, California Highway Patrol's Statewide Integrated Traffic Records System (SWITRS) database processed by the University of California, Berkeley SafeTREC's Transportation Injury Mapping System (TIMS).
- Evaluations of existing and proposed truck Property damage only (PDO) crashes from statewide average accident rates from Caltrans' Life-Cycle Benefit/Cost Model (Cal-B/C).
- Estimates of fuel use and CO_2 from the U.S. Energy Information Administration (EIA).
- Truck emission rates from the U.S. Environmental Protection Agency (EPA).
- Recommended monetized values and BCA methods from the U.S. DOT's Benefit/Cost Analysis Guidance.

Safety Benefits

Data on fatalities, injuries, and property damage only incidents were obtained from each of the 4 States. For States where fatigue-related crash data were not available, fatigue-related crashes were estimated using a factor of 13 percent.[21] The average annual fatigue-related crashes are summarized in Table C.1.

Table C.1 Average Annual Fatigue-Related Crashes on I-10 by State

Summary Crashes	California[a,b]	Arizona[c]	New Mexico[d]	Texas[a]	Average Annual
Fatalities	1.8	0.6	0.7	0.7	3.8
Injuries	40	8	7	14	70
No Injuries	78	15	10	30	133
Total	**120**	**24**	**18**	**44**	**206**

[a] Average based on three years of crash data 2015-2017.
[b] Property crash only (PDO) crashes estimated using statewide highway accident rates from Cal-B/C, accessed 5/24/18.
[c] Average based on five years of crash data 2011-2016.
[d] Average based on three years of crash data 2014-2016.

Mobility Benefits

The mobility benefits from the I-10 Corridor Coalition TPAS project include delay savings to the public using this facility from the reduced crashes, as well as reduced travel times to truck drivers from increased productivity from the available truck parking information.

[21] FMCSA: https://www.fmcsa.dot.gov/safety/driver-safety/cmv-driving-tips-driver-fatigue, accessed 5/23/18.

Crash-Related Travel-Time Benefits

The travel-time benefits to the general public from reduced crashes were estimated using the rates from Table C.2. The I-10 corridor through California, Arizona, New Mexico, and Texas is approximately 25 percent urban and 75 percent rural. Vehicle hours were converted to person hours using an average vehicle occupancy of 1.39 (U.S. DOT Benefit/Cost Analysis Guidance for Discretionary Grant Programs, 2017). Table C.3 presents the estimated annual travel-time savings from reduced crashes.

Table C.2 Estimated Delay Vehicle Hours per Crash

Roadway Type	Fatal	Injury	PDO
Urban Interstate	6,729	2,522	2,144
Rural Interstate	464	159	134

Source: U.S. DOT FMCSA Delay and Environmental Costs of Truck Crashes, 2013.

Table C.3 Estimated Annual Person Hours Delay Saved Due to Reduced Crashes

Roadway Type	Fatal	Injury	PDO	Total Hours
Urban Interstate	877	6,090	9,877	16,844
Rural Interstate	181	1,152	1,852	3,185
Total	**1,059**	**7,242**	**11,729**	**20,030**

Travel-Time Benefits from Truck Driver Productivity Improvements

The travel-time benefits associated with improved truck driver productivity was estimated using TOPS-BC and methods consistent with prior benefit/cost analysis for truck parking information projects. It assumes the available truck parking spaces will be used on average 5 days per week, once per day, with 80 percent utilization. The travel-time benefit was estimated by multiplying the number of available truck parking spaces in the corridor by the estimated utilization (80 percent) and the average time savings (15 minutes). The travel-time benefit to truckers was estimated to be 27,650 hours annually.

Environmental Benefits

The I-10 Corridor Coalition TPAS project will reduce emissions and fuel use from the reduced crashes and improved truck productivity from reduced vehicle miles traveled (VMT). Environmental benefits estimated for this benefit/cost analysis included:

- Crash-related emissions savings.
- Emissions saved from reduced VMT from parking availability information.
- Crash-related fuel savings.
- Fuel savings from reduced VMT from parking availability information.

Crash-Related Emissions Savings

The emissions benefits to the general public from reduced crashes were estimated using the estimated emissions per crash rates in Table C.4. Table C.5 presents the estimated annual emissions savings from reduced crashes.

Table C.4 Estimated Emissions per Crash (short tons)

Roadway Type	CO_2	CO	NOx	PM_{10}	$PM_{2.5}$	SO_2	VOC
Urban Interstate	10.77391	0.07593	0.01957	0.00166	0.0016	0.00019	0.00815
Rural Interstate	1.63494	0.01074	0.00625	0.00034	0.00033	0.00002	0.00073

Source: U.S. DOT FMCSA Delay and Environmental Costs of Truck Crashes, 2013

Table C.5 Estimated Annual Emissions Saved Due to Reduced Crashes (short tons)

Roadway Type	CO_2	CO	NOx	PM_{10}	$PM_{2.5}$	SO_2	VOC
Urban Interstate	55	0.391	0.101	0.009	0.008	0.001	0.043
Rural Interstate	25	0.166	0.096	0.005	0.005	0.000	0.011
Total	**81**	**0.556**	**0.197**	**0.014**	**0.013**	**0.001**	**0.054**

Emissions Benefits from Truck Driver Productivity Improvements

The emissions benefits associated with improved truck driver productivity was estimated using methods consistent with prior benefit/cost analysis for truck parking information projects. The emissions benefits were estimated by multiplying the number of available truck parking spaces in the corridor by the estimated utilization (80 percent), and the average reduced miles traveled (12 miles). The resulting reduction in miles traveled were then multiplied by truck emission rates from the U.S. Environmental Protection Agency.[22] CO_2 reductions were estimated based on fuel use a fuel use rate from the U.S. Energy Information Administration.[23] Instead of using average reduced miles traveled, total fuel savings was estimated (2 gallons saved) instead of miles traveled. The truck emissions rates and the resulting reduction in emissions from improved truck driver productivity are shown in Table C.6.

Table C.6 Annual Emissions Saved from Parking Information (short tons)

Emissions Type	CO_2	VOC	CO	NOx	$PM_{2.5}$	PM_{10}
Emissions Reduction Rate[a]	0.0112	0.447	2.311	8.613	0.202	0.219
Annual Tons Saved	2,477	0.654	3.380	12.6	0.295	0.320

[a] CO_2 emissions rate is in tons per gallon, other emissions are in grams per mile.

Crash-Related Fuel Savings

The fuel benefits to the general public from reduced crashes were calculated using the estimated excess fuel burned per crash rates shown in Table C.7. Table C.8 presents the estimated annual fuel savings from reduced crashes.

Table C.7 Estimated Excess Fuel Burned per Crash (gallons)

Roadway Type	Fatal	Injury	PDO
Urban Interstate	2,655.95	995.54	846.03
Rural Interstate	483.72	165.18	139.43

Source: U.S. DOT FMCSA Delay and Environmental Costs of Truck Crashes, 2013.

Table C.8 Estimated Annual Fuel Saved Due to Reduced Crashes (gallons)

Roadway Type	Fatal	Injury	PDO	Total Gallons
Urban Interstate	249	1,729	2,804	4,783
Rural Interstate	136	861	1,386	2,383
Total	**385**	**2,590**	**4,190**	**7,166**

Fuel Savings from Reduced VMT from Parking Availability Information

The fuel savings benefits associated with improved truck driver productivity was estimated using methods consistent with prior benefit/cost analysis for truck parking information projects. The fuel benefit was estimated by multiplying the number of available truck parking spaces in the corridor by the estimated utilization (80 percent), and the average fuel savings (2 gallons). The estimated fuel savings benefit to truckers was estimated to be 221,200 gallons annually.

[22] https://nepis.epa.gov/Exe/ZyPDF.cgi/P100EVY6.PDF?Dockey=P100EVY6.PDF, accessed 5/23/18.
[23] https://www.eia.gov/tools/faqs/faq.php?id=307&t=11, accessed 5/23/18.

Vehicle Operating Costs Benefits

The I-10 Corridor Coalition TPAS project is anticipated to reduce vehicle miles traveled which reduces vehicle operating costs. The vehicle operating costs benefit was estimated by multiplying the number of available truck parking spaces in the corridor by the estimated utilization (80 percent), and the estimated miles saved (15 miles). The estimated reduction in vehicle miles was estimated to be 1,327,200 miles annually.

Monetized Benefits Summary

The estimated benefits above were monetized using the rates shown below. Rates shown are in 2018 dollars. Rates were adjusted to 2018 dollars using an inflation rate of 3 percent consistent with TOPS-BC.

- Travel Time (per hour), from U.S. DOT Benefit/Cost Analysis Guidance for Discretionary Grant Programs, 2017:
  - Truck—$28.86
  - All purposes—$14.96
- Crashes (per occurrence), from U.S. DOT Benefit/Cost Analysis Guidance for Discretionary Grant Programs, 2017:
  - Fatality—$10,184,640
  - Injury—$184,597
  - Property Damage Only (PDO)—$4,511
  - KABCO—Incapacitating—$487,059
  - KABCO—Nonincapacitating—$132,613
  - KABCO—Possible Injury—$67,792
  - KABCO—No Injury—$3,395
- Fuel Use (per gallon excluding taxes), from EIA, 5-21-18—$3.28.
- Nonfuel Operating Costs for Truck (per VMT), from U.S. DOT Benefit/Cost Analysis Guidance for Discretionary Grant Programs, 2017—$1.02.
- Emission Cost (per short ton), CO and CO2 from TOPS-BC and others from U.S. DOT Benefit/Cost Analysis Guidance for Discretionary Grant Programs, 2017:
  - CO—$74
  - CO_2—$39
  - NOx—$7,826
  - PM—$358,010
  - VOC—$1,986
  - SO_2—$46,255

Table C.9 presents the expected annual monetary benefits for safety, mobility (travel time), environment (emissions and fuel use), and operating costs (vehicle operating costs) from the benefits analysis results.

Table C.9 Summary of I-10 Corridor Coalition TPAS Project Annual Benefits
$ Millions

	Safety	Travel Time	Environmental	Operating	Total
Annual Monetary Benefit	$5.1	$1.0	$1.2	$1.4	$8.7

Costs Analysis

The costs analysis was informed by inputs from:

- Vendor cost estimates for equipment, installation, warranty, and operations and maintenance costs.
- Cost estimates and operations and maintenance costs and useful life information from the FHWA ITS Cost Database and FHWA TOPS-BC.

The full programmatic costs associated with the I-10 Corridor Coalition TPAS project is estimated to be $13,700,000. This estimate includes PS&E, procurement, construction, and integration, construction management, and agency costs. A summary of the costs for the TPAS project elements is included in Table C.10.

Table C.10 Cost Estimates for I-10 Corridor Coalition TPAS Project Elements

Plan Elements	Full Programmatic Costs	Annual O&M Costs
Truck Parking Occupancy	$4,390,000	$329,000
Dynamic Parking Capacity Signs	$8,030,000	$243,000
I-10 Corridor Coalition TPAS Web/ Smartphone App and Integration	$1,280,000	$100,000
I-10 Corridor Coalition TPAS Totals	**$13,700,000**	**$672,000**

Benefit/Cost Analysis

The benefit/cost analysis for the I-10 Corridor Coalition TPAS project was conducted based on the U.S. DOT Benefit/Cost Analysis Guidance for Discretionary Grant Programs (2017) using a 20-year analysis period. Both the recommended 7 percent discount rate, and 3 percent sensitivity analysis, were calculated, as well as the undiscounted values. A summary of the benefit/cost analysis is shown in Table C.11. As shown, the project is estimated to have a benefit/cost ratio ranging between 4.7 and 6.3.

Table C.11 Benefit/Cost Summary for I-10 Corridor Coalition TPAS Project
Average Annual Values (2018)

Performance Measure	Undiscounted	3% Discount Rate	7% Discount Rate
Safety	$4,692,000	$3,408,000	$2,339,000
Mobility	$1,016,000	$738,000	$506,000
Environmental	$1,094,000	$794,000	$545,000
Vehicle Operating Costs	$1,251,000	$908,000	$623,000
Total Annual Benefit	$8,053,000	$5,848,000	$4,013,000
Total Annual Costs	$1,273,000	$1,052,000	$860,000
Benefit/Cost Ratio	6.3	5.6	4.7

APPENDIX D: LIST OF ACRONYMS

Term	Definition
API	Application program interface
ATCMTD	Advanced Transportation and Congestion Management Technologies Deployment
ATMS	Advanced transportation management system
AZDOT	Arizona Department of Transportation
BCA	Benefit/Cost Analysis
BCR	Benefit/Cost Ratio
Caltrans	California Department of Transportation
CCTV	Closed-circuit television
CMRS	Commercial Mobile Radio Service
ConOps	Concept of operations
DPCS	Dynamic parking capacity signs
DSRC	Dedicated short-range communications
EIA	U.S. Energy Information Administration
ELD	Electronic logging device
EPA	U.S. Environmental Protection Agency
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRATIS	Freight Advanced Traveler Information System
HOS	Hours of service
I-	Interstate
IT	Information technology
ITD	Innovative Technology Deployment
ITS	Intelligent transportation systems
JPO	Joint Program Office
MPO	Metropolitan Planning Organization
NMDOT	New Mexico Department of Transportation
NOFO	Notice of Funding Opportunity
O&M	Operations and maintenance
PDO	Property damage only
PP/TLD	Program Plan and Top-Level Design
RFID	Radio-frequency identification
ROW	Right-of-way
SWITRS	Statewide Integrated Traffic Records System (California)
TIMS	Transportation Injury Mapping System (California)
TMC	Transportation management center
TPAS	Truck parking availability system
TOPS-BC	Tool for Operations Benefit/Cost Analysis
TxDOT	Texas Department of Transportation
U.S. DOT	United States Department of Transportation
V2I	Vehicle to infrastructure
V2V	Vehicle to vehicle
WiFi	Wireless fidelity